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THE GLORY OF BRITAIN

By

DAVID MASTERS

WITH 25 ILLUSTRATIONS

LONDON
JOHN LANE THE BODLEY HEAD LIMITED

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FOREWORD

SCATTERED along the banks of the Nile are mounds of sand and heaps of debris to remind us of the vanished greatness of ancient Egypt; at Knossos, in Crete, lie the remains of another old civilization that bloomed and decayed; Babylon and Nineveh dominated the then known world and are now no more than rubble under the heels of the Arab diggers; Greece attained power and developed beauty ere she sank into oblivion, and the mighty Roman Empire held the world in thrall before it, too, perished; Spain waxed and waned, France had her years of mastery —throughout human existence the same story is repeated: the rise and fall, the flow and ebb of nations. Is the British Empire, then, destined to fall? Nothing is permanent, but *The Glory of Britain* is the measure of my own faith, and the following pages disclose my prophecy concerning the future of our race.

DAVID MASTERS.

1930.

ACKNOWLEDGMENT

TO the gentlemen who have been kind enough to read in manuscript those sections of my book devoted to the subjects in which they are the acknowledged leaders, and to those who have been good enough to allow me to use certain photographs to illustrate my text, I tender my thanks.

DAVID MASTERS.

CONTENTS

CHAP.		PAGE
I.	Looking Round	1
II.	When the World walked	12
III.	Concerning the Sea	29
IV.	Triumphs of Road and Air	49
V.	Magic Steel	69
VI.	Four Lancashire Geniuses and one from Nottinghamshire	89
VII.	Transmuting Trees into Silk	109
VIII.	Electrical Wonders	121
IX.	Britain's Medical Miracles	149
X.	Solving some Baffling Mysteries	167
XI.	Pirates and Pioneers	180
XII.	Music, Paint, and Printing Ink	209
XIII.	Some Scientific Triumphs	228
XIV.	Our Daily Bread—and Meat	244
XV.	Men and Monkeys	253
XVI.	This Way to the British Empire	261
XVII.	Britain the Beneficent	280

CHAP. PAGE

XVIII. A Letter from Sir Francis Drake, the Passing of Nelson, and the Eclipse of Napoleon . 290

XIX. The British Navy saves the World . . 306

XX. Britain always Pays 324

XXI. Honour where due 340

XXII. Glory without End! 348

Index 353

LIST OF ILLUSTRATIONS

The Flag of Freedom	*Frontispiece*
	FACING PAGE
Cobham Mill	6
A Sussex Homestead	10
The First Passenger Railway	20
Giants of Steel and Steam	26
Queen of the Atlantic	42
Sir Henry Segrave in Florida	66
The Prince of Wales with Sir Robert Hadfield	80
Manganese Steel—An Object Lesson	84
A Bonfire in Bombay	106
Two Geniuses of the New Age	144
Sir Ronald Ross in India	164
The Tomb of Tutankhamen	176
Colonel Norton nearly at the top of Everest	202
Captain Scott at the South Pole	206
Sir Christopher Wren's Masterpiece	212
Where Shakespeare learned his Lessons	220

FACING PAGE

Growing Wheat in Cages 250

Where Empire Makers are Bred 264

The Mother of Parliaments 286

Birthplace of Mary Queen of Scots . . . 292

Salving the German Fleet 318

The Author going Diving 320

The World's Historic First Film 344

THE GLORY OF BRITAIN

CHAPTER I

LOOKING ROUND

"It's a nice little world to live in,
To lend or to spend or to give in,
But to beg or borrow or ask for one's own,
It's the worst little world that ever was known!"

ALL the wisdom of ages and sages is wrapped up in those four lines. As poetry they are negligible, but as truth they are incontrovertible.

Particularly apposite at this juncture in the affairs of Britain is the remark:

"Lend money and lose a friend."

In the past few years the British people have lent quite a lot of money, but, instead of meeting with gratitude from the recipients, we are called names for daring to suggest that it is time some of the money were repaid.

Perhaps it were too much to expect gratitude!

A well-known politician—I believe it was Disraeli—when assailed in the House of Commons, turned upon the gentleman and blandly intimated that he could not understand the reason for the attack. "I have never done the honourable member a favour!" he explained to the House.

Obviously he knew what to expect from those who accept favours. And the present experiences of the British nation prove that human nature is fairly constant,

for our generosity has led to much bad feeling, which is repressed as far as possible, but sometimes it breaks out, and then it comes as rather a shock to those who can see things in their proper perspective.

This matter of perspective is not unimportant in life and art. When things are out of perspective, if the painter cannot observe things accurately, the whole picture becomes distorted and unreal. Now the picture of the British race is magnificent and noble, and no single hand could limn the whole of it in pigment or word, for it is far too vast a canvas for one man to cover. Should I succeed in correcting the perspective a little here and there, and giving proper proportions to a figure or two in the national canvas, then it may well be that we shall see the foreground of to-day emerging a little clearer out of the background of the past. If I am able to clarify the picture even in the smallest degree, to disperse the mist, be it ever so slightly, then my labour were not in vain.

That the British, as a race, are peculiar, few will deny. We are individualistic to a degree, preferring much rather to compete with each other than to co-operate. And it was this competition in the past, this sturdy independence, which brought out the best in our people, called forth that further effort to beat his neighbour and do something just a little better or quicker, those efforts which in the aggregate lifted Britain until she dominated the world and gave her the right to inscribe herself GREAT BRITAIN.

There was no trace of vainglory, no atom of boastfulness in that word GREAT. Britain *was* great. The whole world envied her, courted her, sought for alliances and treaties with her. From all corners of the globe tribute flowed to Britain. Our ships sailed all the seas, the ensign fluttering in the breeze giving them a sense of security, ennobling their captains into Ambassadors of Britain, strong in the power of Britain's might, staunch in her sense of justice. If in some distant port or on some far sea they met with unjust treatment, they

knew that Britain would protect them. And the merciful and just attitude of our sea captains became so marked that races of other types and colours came to regard the Union Jack as a symbol of fair treatment. Lesser men there were, of course, who were neither kind nor strictly impartial, but the majority were good seamen who calmly and without fuss most ably upheld the honour and glory of England. In being true to themselves, they were true to their country.

Britain WAS great! But is she so now? Does the cloak of greatness still hang firmly from her shoulders and provide a generous hem under which weaker peoples may shelter? That is a question which To-morrow may answer. By considering what we were yesterday, and what we are to-day, we may arrive at some idea of our destiny to-morrow.

We are, as I have already written, a peculiar people, with a strange reserve and taciturnity which our continental neighbours cannot understand. We do not talk so easily; we have not the charming ways nor the ready tongues of our Gallic friends. To them it is so simple to say "Good morning" to their fellow-passengers when starting on a railway journey. They chat with each other as a matter of course, and the habit certainly relieves the tedium of the journey and makes the time pass quickly. But with us it is difficult. The suggestion has been made that it is like pulling out his teeth to get a word from an Englishman abroad. If all the Englishmen hailed from Aberdeen, when of course they would be Englishmen no longer, we should say they were afraid of giving something away.

I am rather like that myself. Often I have spent twenty-four or thirty-six hours cooped up with the same passengers in the same railway compartment without saying a single word to a soul, except to give instructions to the railway porter or to order my meals in the dining-car. It seems so unfriendly, yet I have no antagonism toward my fellow-travellers. I simply hesitate to intrude on them.

Half the time the reason why British people do not talk in railway carriages abroad is because they have not been introduced to the other passengers. If the continental trains were all provided with an official introducer, and if only the English would not seek to ventilate the compartments by opening windows, I am sure that the continental peoples would understand us a little better.

As against the travelling Britons who, owing to shyness or some other reasons, do not talk at all, there are those travelling Britons who talk much too loudly, as though they owned the place. And these again give a totally wrong impression of the British nation, for judging by them one would expect us to be overbearing and bombastic. Yet we are neither.

The continental peoples are articulate, full of nervous energy and cajolery and flattery, using the words which will serve their purpose at the moment and not meaning much that they say. We, on the other hand, are not articulate enough ; we say a few words when we are compelled and sometimes mean a very great deal more than we utter, with the result that if we are really stirred we are rather apt to surprise foreigners by the lengths to which we go. When they say they won't, it is always with the mental reservation that they will if circumstances compel them or the policy prove profitable. This is their own mentality, which they understand thoroughly because they have been dealing with it all their lives. They are consequently apt to be sadly misled by the Englishman who means much more than he says and keeps his word. If, owing to English stolidity and their own racial characteristic of trying to juggle just a little more out of some business deal, that deal falls through, continental lamentations are both sincere and amusing. Our friends complain that they have been deceived, and ask plaintively how they were to know that the other man meant it !

Of course the cosmopolitan virus has infected us rather badly, and the consequence is that there is a

greater number of people than ever to-day who love every other country but their own. Foreign musicians, foreign dancers, foreign books, anything foreign is welcomed with open arms, while the British artists and musicians and dancers, tired of the neglect of their fellow-countrymen, are forced to go scouring the world for the recognition they deserve, before they can return for the plaudits of the multitudes at home. And if our own artists did not obtain recognition of their merits abroad, it would prove that other lands were prepared to honour their own prophets instead of ours. But actually those other lands, while nursing and cultivating their home talent, are equally pleased to welcome the stranger from without the gate, so they resemble us slightly, though to a far lesser degree. Where they find home talent they nurture it for the good of their country, whereas our tendency is to starve native talent and accept at its own valuation anything foreign that can manage to get into the country.

" How wonderful ! How marvellous ! " we exclaim of the foreigners. Whether this is due to the foreigners being able to suspend our critical faculties, or whether it derives from the desire to be generous to our guests, is a matter which the psychologists may determine. I mention it as a fact in passing.

A decided tendency among Britons abroad to decry their own race cannot be ignored. They forgather in the fashionable watering-places on the Mediterranean, and sometimes, when they are not drinking cocktails, or gaming at the tables, or dancing or playing tennis, they turn their thoughts to Britain and her problems, and murmur : " We're done ! "

One day, in France, I happened to be chatting with a Vice-Consul about the attitude of the people. " There seems to be a good deal of bad feeling below the surface," I said.

" I'm afraid they don't like us," he admitted.

They are polite to us and tolerate us while we go there to spend our money, but deep down there is a

bitterness which is not pleasant. This sometimes manifests in the most unexpected place and manner. I recollect once in the dining-car of a train rushing towards the Mediterranean that a Frenchman started to make rude remarks about the English, because he had to pay the same price for his lunch as I did. He thought, as the franc had depreciated, that I should pay four or five times as much as a native of the country. I pointed out to him that depreciating the franc had cost unhappy Britons millions of pounds, for their French investments had depreciated accordingly, and that if I had a meal in France at a reasonable price, at any rate I paid for it in other directions, which was no more and no less than the truth.

When this feeling is abroad, and our people who have more money than sense keep dropping remarks in those gaudy palaces of pleasure that we, as a race, are done, it would be futile to expect other nations to imagine that all was well with us.

That heart-rending European catastrophe of 1914–1918, with its endless and fruitless sacrifice of humanity, made the whole world sigh for Peace. But the signing of the treaty at Versailles merely set us fighting in another way. Life, from beginning to end, is a war. In my garden the weeds are fighting with the grass on the lawn for the food that is in the soil, the apple trees struggling to survive and produce fruit are attacked by the woolly aphis, which does not know that in sucking up the sap of the tree it is doing its best to kill the very organism which sustains it.

Everywhere you look it is the same. The fight for life! And the signing of the Peace Treaty has merely flung the armies into the factories and fields, where they must struggle with the soil or machinery to beat their opponents in that endless war for the trade by which nations exist.

To me this is the Golden Age of Miracles. I am thrilled by all sorts of commonplace things which leave the masses quite unperturbed. But, even in this age,

PERSONS WHO ARE APT TO RAVE OVER FOREIGN BEAUTY SPOTS ARE OFTEN IGNORANT OF THE BEAUTIES OUTSIDE THEIR OWN DOORS. THIS LOVELY OLD MILL AT COBHAM IN SURREY IS ONLY A FEW MILES FROM LONDON, AND IF IT WERE POSSESSED BY SOME OTHER COUNTRY IT WOULD BE FAMOUS THE WORLD OVER

it would be expecting too much to imagine that the lesser powers were not jealous of Great Britain. We, as a race, have dominated the earth and them. They would be less than human if they could restrain a feeling of satisfaction at gaining some of our trade in foreign markets, at lowering our pride, if only a little.

In the marts and market-places of the world the merchants whisper together and smile and rub their hands. They buy or refrain from buying, and factories expand or close down. They are the captains and generals of the civilian armies; they can make men happy in their work or wretched in unemployment. And at the moment their talk of Britain has a sinister ring.

In the bazaars of India there is disquiet, rumours slip from tongue to ear and go on and on. They can no more be caught than can the cloud scudding across the sky. British politicians in their blindness and prejudice and folly and generosity add to the rumours. And a friend of mine in that seething turmoil sits working with a revolver on his desk, wondering when the rising will come and what will happen if the hordes really break loose. Meanwhile, the diverse sects and castes get ready to spring at each other's throats, and that united India which Britain has created threatens to disrupt into an endless series of fanatical civil wars.

Ancient Egypt, which Britain has wakened from the lethargy of the past and modernized and irrigated into prosperity, is troubled. The Egyptian students have imbibed too deeply of strange notions, and the politicians have used them for their own ends. Night after night there are meetings in the native quarters, and the dwellers in Cairo and Luxor laugh openly and say that the hand of Britain has grown too weak to rule.

"Rule yourselves!" says the Labour Government of Great Britain.

Level-headed Egyptians who know the weakness of their countrymen, and who have seen in the last forty years their country rise from poverty to prosperity under

such fine men as Cromer, are frankly afraid of what is going to happen. The masses in Great Britain seem to know little and care less, for there are troubles enough and to spare at home without shouldering the troubles of other people.

Nor can I avoid reference to Russia. There are many people with many motives who regard Russia as an earthly Paradise, and openly decry their own country while praising a land which is stricken with decay and faced with famine. Russia is far away, another world where the theories, which might have worked out fairly well if the whole nation had been highly intelligent and educated, break down before the stupidity and ignorance of the people. To create an ideal state out of an unintelligent populace, the majority of whom regard reading and writing as something utterly beyond them, were an impossibility. A friend who spent nine months in a Bolshevik prison, in constant fear of death, convinced me that the finest cure for those people who favour Russia and revile England is to send them to Russia and compel them to remain.

Last century a man had to work or starve. Shopkeepers could keep open all night if they liked, and they took advantage of this liberty by keeping their assistants at work for such long hours that the unions quite rightly sprang to life to mitigate the hardships of the oppressed. To-day it is otherwise, and if I buy milk for a child after eight o'clock at night I am committing a crime punishable by law, though I may buy spirits or beer with impunity. And a restaurant may sell me food to eat on the spot or a cup of coffee to drink, but if it be early closing day it may not sell me half a pound of coffee so that I may make my cup of coffee at home. An assistant in a restaurant once handed me a packet of coffee about 2.15 one afternoon and then demanded it back again. "I'm sorry, sir; I can't sell it to you. It's early closing day," she explained. She had the coffee to sell, I had the money to pay for it, but the law stepped in and turned a perfectly innocent transaction

of buying and selling into a crime. There must be a way out. If some people say that the bad old days have given place to the bad new days, their suggestion is not entirely free from foundation.

The question arises whether some of the laws and the rules and regulations that are enforced in the interests of the people are really benefiting them or harming them. Since the war a new generation has come to maturity, and there are many young men and women to-day who have never worked at all. Owing to the unsettled condition of our country, and the unemployment which is rife, these young people have been taken care of by the State, which has made them an allowance on which they have been able to subsist, with the result that they are not particularly keen to earn their own living. If the State will keep them for doing nothing, why should they worry themselves about earning a living?

"In the sweat of thy face shalt thou eat bread," says the Bible.

Those who eat bread by the sweat of someone else's brow will in time develop an irresponsible nature; they are inclined to think that their daily bread falls direct from heaven, and anything which induces such a mental attitude is destined to rob the race of that vitality and sturdy independence which made Britain truly great.

As a nation, we assume that deeds speak louder than words. But are we right? It may have been so a few years ago, before publicity had grown into a fine art. Now, when industries and nations are beginning to live by advertising, when the loudest speakers demand and compel attention, the idea that deeds speak louder than words seems woefully out of date.

We are living in a new age, and surely we must adapt our methods to the age in which we live. The innate modesty of our race urges us to do things and say nothing about them. To mention that we have done this or that is considered such bad form.

"It isn't done, you know!"

Britain has accomplished so much that few realize the sum of her achievements. Half a century of free education has not managed to instil the reason for our greatness into the minds of the masses. Many people who once understood have since forgotten under recurring troubles. A large number of people have even forgotten to be patriots. They say that patriotism is out of date, so they are international. They love all the world, and are so busy loving it that they have no affection left for their own country.

Canon S. A. Alexander, in a sermon in St. Paul's Cathedral, said: "True patriotism will always put honour before safety, and moral greatness before prosperity. I do not know why it should be regarded as the mark of a liberal mind to be interested in international movements while forgetful of the country to which, after all, we inevitably belong."

Patriotism is indeed a fine thing, a noble thing. It is not a sentiment to be ashamed of. The country that bore us and bred us has beauties unmatched the world over. A lady who saw Monte Carlo for the first time exclaimed: "There are places in Scotland that I like better!" I myself have been threatened with a foreign legal action for daring to say that there are British watering-places lovelier than Nice.

What city in the world will compare with London, whose heart is a green country, jewelled with flowers and trees, where flocks of sheep feed as though they were in far-distant pastures; what view with that of the winding Thames from the terrace at Richmond; what peace with the hallowed quietness of Westminster Hall, which is an oasis of silence in a howling wilderness of noise; what vista with that from St. James's Park across the Horse Guards' Parade when the afternoon sun, gilding the towers and minarets in the background, magically conjures up the very spirit of the East? We may well praise our London, for it is so full of beauties that the discerning eye can never see their end.

Meadows of lush grass gilded with buttercups in the

H SCENES AS TIFUL OLD FARM IN SUSSEX ARE THE ENGLISH COUNTRYSID SEEING
ONE CAN UNDERSTAND WHY ESE ISLANDS EXERCISE SUCH A CHAR ER PEOPLE AND LAY SO STRONG A HOLD ON
THEIR AFFECTIONS

spring, hedges of hawthorn with their almond-scented blossom, winding rivers and shady woods, unspoiled hamlets nestling in the dales, mountains with great splashes of purple heather, rocky bays with seas curling over the golden sand—these be beauties to dream on. They are our heritage, and they have bred a race of men who have helped to sweep away the dark ages and replace them by something better, the civilization of to-day.

Owing to those peculiarities on which I have touched in this chapter, to the jealousy and enmity of many people, to other factors far too numerous to trace, the opinion is widely held abroad that we are becoming decadent, that Great Britain has seen the pinnacle of her glory and that her sun is setting.

Not by one fraction would I minimize the serious condition of our dear land. She is, indeed, in a parlous state. But I think Great Britain in her hour of tribulation is greater than ever ; and that if the world knew how much Civilization owes to the inventive genius of these islands, to the noble ideas conceived by British brains which have helped to benefit and remould humanity, they would cease to jeer at us as a nation of shopkeepers and see us clearly as a nation of men.

While some of the nations seek to deplete our coffers, let us at least compel them to give us full credit for our actions and inventions.

It is not money alone that they owe to us, but some of the greatest blessings that they now enjoy.

CHAPTER II

WHEN THE WORLD WALKED

WATER fascinates me. The ripples on the surface of a brook as it slides under a rustic bridge, the wide sweeps and eddies of a stream, the upheaving and breaking of a wave as it dashes impetuously on the shore and retreats with its booty of shingle or sand, compel my attention. Water is the source of all life. Without it, life would cease to be.

I marvel at the power of waves which distort and break giant girders, those waves which hurl themselves with the force of a solid against the solid steel and shatter it. I think of the might that is locked up in water, its marvellous characteristic of absorbing heat and storing it up for our use. As a sponge soaks up water, so does water soak up heat, as though water were composed of little balloons in which tiny bagfuls of heat could be stored for making our cups of tea and coffee. And when the water has absorbed as much heat as it can hold, a magic change comes over it. The heat changes the molecules of water into a steamy vapour which possesses tremendous strength and power. Steam is the slave of humanity, and the man who found out how to harness it and bend it to his will is one of the greatest benefactors the world has ever known.

That man was James Watt, a Scotsman, whose inventions wrought more change on the surface of the earth than all the inventions of all the men who had gone before. Born in Greenock on January 19, 1736, Watt, whose father was a builder and carpenter as well as a shipowner, was a puny child whose health gave his

parents a good deal of anxiety, so much so that they dared not send him to school in his early years, but were forced to let him have his lessons at home.

When at length he went to school, his schoolfellows ragged him unmercifully and used their virile strength to impose on his bodily weakness. Nor did the genius that he possessed shine out in those early days. Geometry and the dead languages of Latin and Greek came easily to him, but as so many other boys were just as proficient as he in these subjects there was little indication that Watt was going to alter the world.

The manual dexterity he disclosed in his father's workshop led to him taking up the trade of a mathematical instrument maker, and apparently it was considered that one who could make mathematical instruments could do anything, for among the diverse things which found their way into his hands to be doctored and made whole again were fiddles and fishing-rods ! Gaining some insight into the mysteries of his craft he, after staying for some time with relatives in Glasgow, packed up his belongings and sent them down to the quay to be placed aboard a ship bound for London ; then he mounted a horse and started to trot southward, traversing roads that were little more than bridle tracks, and reaching the metropolis twelve days later, a journey that now takes eight hours by train.

To-day London's atmosphere is improving. Electricity and gas are used more and more for heating and cooking purposes, and coal fires are used less, so the air above the city is becoming purer. Now and again, however, a dense fog will cloak the whole city to remind us that London has a world-wide reputation for fogs, and that the pea-soup fog known as a " London particular " was an affliction which the inhabitants of old had to suffer every autumn and winter.

A strong constitution might survive these fogs of the capital, but a year working in Cornhill was as much as James Watt, in his weakly state of health, could tolerate. Repacking his few goods, he returned to Greenock and

then to Glasgow, where he made up his mind to pursue his trade and open a shop.

There he met the full opposition of the forerunner of the modern union. The Glasgow Hammermen's Guild simply would not allow him to earn his living in this way. He had not served his time as an apprentice, and they would not permit an outsider to enter their ranks. If they had succeeded in driving him out of the city, they might have robbed the world of steam-power for many years. That they did not succeed in driving him away was providential; their very opposition was providential, too, for it compelled his friends to find him a post as mathematical instrument maker to the University of Glasgow, otherwise he might never have seen the faulty Newcomen steam-engine at the University, which he was asked to repair in 1763.

No one can deny the genius of Watt; it is plain enough without seeking any adornment. Yet someone sought to add to his fame by telling a story of Watt as a child making infantile experiments with a steaming kettle. The story still persists, although it is utterly untrue. Every child at some time may be interested in the phenomenon of steam gushing out of the spout of a kettle and the lid rattling away noisily under the pressure; if Watt himself was similarly interested, it was just idle childish curiosity and nothing more.

Nor was Watt the first man to be inveigled by the mysteries of steam. Before his day, Denis Papin, the Frenchman, invented the safety-valve for his steam-cooker during his stay in England; it was a long rod with a weight on it, just like some of the weighing-machines in use to-day. By shifting the weight the valve could be so adjusted that if the steam inside rose to the danger point, the pressure simply lifted the weight and allowed the excess steam to escape. Papin, driven from France by religious persecution, became assistant to the great Robert Boyle, who brought the Frenchman to the notice of the Royal Society. At the age of forty, in 1687, he became Professor of Mathematics at a

German University, nursing in his mind the idea of obtaining power from the pressure of the atmosphere. Experiments with explosives finally led to his inventing a pump in which steam was used to raise a piston and create a vacuum. Naturally, when the condensing steam performed its task, there was no cushion of air inside to hold the piston up, and the pressure of the air outside pushed the piston down again.

This was not a steam-engine at all, but an air-pressure engine. And it was an improvement on this engine which the Cornishman Newcomen made to pump out mines some years later. Newcomen's steam-engine was also an air-pressure engine, for in it the air pressure was the prime factor, and the steam was merely the sleeping partner whose giant strength remained to be recognized and properly harnessed.

Taking that Newcomen engine to pieces and putting it together again in 1763 awakened the latent talent of Watt, who, after inventing a separate steam-condenser the following year and making several improvements, realized that if steam could lift a piston it could also force it down again. Setting to work, he made a piston with a steam-valve at each end, so that directly the steam had pushed the piston right up, another jet of steam entered at the top of the piston and drove it down. This was the stroke of genius.

The first real reciprocating steam-engine was thereupon born, and the power which sets the kettle singing cheerily on the hob and the lid dancing merrily to the tune was caught and tamed to work for all humanity. When due credit is given to the other men who had experimented with steam, the simple fact remains that Watt really mastered it. He added the heavy flywheel to the steam-engine to make it run evenly and smoothly, he adapted the governor, whose arms spinning round are automatically raised or lowered, to control the amount of steam admitted and prevent the engine from racing.

Yet he had to struggle to perfect his engine, and money was essential to enable him to carry out his ideas.

Fortunately, Dr. Roebuck of the Carron Iron Works was sufficiently interested to acquire a two-third share in the new invention which Watt patented in 1769. Roebuck's faith was obvious, but financial difficulties overtook him and he found himself owing £1200 to Matthew Boulton of the Soho Works, Birmingham, whereupon the introduction of a friend brought Watt into contact with Boulton and led to their partnership. Foolish as it may seem nowadays, Roebuck's creditors thought so little of the steam-engine that they regarded it as quite worthless, and they willingly allowed the debtor to assign to Boulton his interest in the invention as repayment for the £1200 !

The new partnership proved a happy one, and no praise can be too high for the way Boulton encouraged the inventor when the latter was despondent owing to the many difficulties he met with. Important as is money in developing anything new, a helpful word may sometimes mean the difference between success and failure, and a kindly pat on the back may work wonders. Boulton realized this, and the two men consequently worked amicably together building the new engines at the Soho Works.

That Boulton was a good judge of a man was proved by his faith in Watt ; his business acumen and sagacity were further revealed by his engagement of William Murdock at a wage of 15s. a week. Murdock is another Scottish genius who left his mark on civilization. Not least of his inventions was the special valve that slid to and fro at each stroke of the piston and controlled the exit and entry of steam to the cylinder. It proved in 1785 to be an important factor in the development of the steam-engine.

In Newcomen's air-pressure pump, which the ironmonger-inventor—who had previously learned a great deal through helping Savery to make parts for his air-pressure engine—completed in 1705 and called a " fire-engine," it was essential for someone to stand by and pull a rope regularly at the end of each stroke to open a valve and allow the steam to escape.

The story generally told and accepted, but the truth of which I cannot verify, is that young Humphrey Potter, when he was set to work pulling the rope to open the valve of a Newcomen engine, became more and more tired of the monotony of his task. Seeking to escape it, he noticed that every time he pulled the rope to open the valve, the beam above his head, which was part of the engine, swung up also. Into the lazy lad's head came the thought that if he tied a cord to the beam and then to the valve, the beam as it rose might open the valve for him and enable him to run away and play. He tied the end of his rope to the beam, and after adjusting the length found that his idea worked perfectly.

Newcomen, coming into the engine-room, was furious at seeing the boy shirking his job. "You lazy little beggar!" said the inventor, and kicked him out. But directly his anger had passed he realized that the valve was opened with much greater regularity by the rope which Humphrey Potter had attached to it than it had ever been operated by hand, and thus out of sheer laziness the levers were developed which automatically closed and opened the valve, a most important invention.

The end of the eighteenth century and the early days of the nineteenth century witnessed the flowering of the engineering genius of Great Britain. Watt, who had done so much for the world, might have done still more had he been liberally minded. He was infuriated because a workman of his stole one of his brilliant ideas and sold it to an engineer, who patented it, and thereby retarded the development of his steam-engine. But, despite all that has been said to the contrary, there is little doubt that Watt himself was so jealous of his inventions, so determined to enjoy the full benefit of them, that he could brook no rival. Had he been a little different, and given the necessary encouragement, the world might have had railways many years before they were an accomplished fact.

Not only was he the Father of the steam-engine, but he might have acted almost as important a part in the

development of railways as Stephenson afterwards played. The chance was within his grasp and he refused to take it. How a man who was so wide-awake and open-eyed in one direction could be so blind in another is one of the puzzles of human nature.

Murdock was also a genius, entirely self-taught, and when Watt and Boulton sent him to Cornwall to instal their engines for pumping out the mines, he spent his spare time in making a model steam-locomotive with a pair of big wheels and a small wheel in front. Lighting a lamp under the boiler, he raised a head of steam and set his model coursing round the room, to the delight of all his friends.

In those days, probably more people believed in witches than in fairies. At any rate, Murdock, one night in 1784, took his model out on the road leading up to Redruth Vicarage and set it full steam ahead, imagining that he could easily keep pace with it. He happened to be mistaken, for the little locomotive rushed right away. Murdock, panting after it, soon heard shrieks of dismay and terror, and in a little while came across the local parson, who thought that Satan himself was about to attack him. Instead of allowing Murdock to develop that model, Watt kept him busy at other things, thus relinquishing a fine opportunity.

The truth is, that Murdock was too good a man for the partners to lose, as they admitted to each other in their letters. Boulton himself, on the way down to Cornwall, met Murdock in the coach proceeding to London, and found that the latter was taking his model to town to obtain a patent for it. Boulton, concerned about their steam-engines in the Cornish mines, for which the partners received a yearly sum in royalties, talked his engineer out of his project and induced him to return with him to Cornwall. Afterwards Boulton wrote to Watt : " I think it fortunate I met him, as I am persuaded I can either cure him of his disorder or turn the evil to good."

That was how Watt and Boulton regarded the beneficent invention of the steam-locomotive—as an evil! On September 12, 1786, Watt wrote to Boulton: "I am extremely sorry that William Murdock still busies himself about steam-carriages. . . . I wish William could be brought to do as we do, to mind the business in hand and let such as Symington and Sadler throw away their time and money in hunting shadows." Which explains why Murdock's invention was doomed to remain undeveloped by that genius, and why it remained unpatented.

At the time that Murdock's little locomotive was puffing about his room, Richard Trevithick, who was born near Redruth in Cornwall, was thirteen years old. Of all the boys who ever attended school, none was more of a handful than he. Often he played truant, and upon going to school simply would not attend to his lessons, while if his teacher attempted to force him to do anything he only became more obstinate and disobedient. Still Trevithick was no fool, and the sight of Murdock's little engine running about so captured his imagination that some years afterwards it inspired him to build a better locomotive. In 1790 his father was earning 40s. a month as the engineer of Stray Park Mine, and Richard was helping him for a wage of 30s. a month. The practical experience he gained enabled him to hammer away at Tyacks, the blacksmith's shop at Camborne, and build his own locomotive. On Christmas Eve, 1801, he got aboard with several passengers and steamed easily along the bad roads.

The ignorant Cornish people thought this first passenger steam-locomotive was an invention of the devil, but Trevithick did not care. He was possessed of the enthusiasm of the true inventor. Sure that his high-pressure steam-engine was better than the invention of Watt, he had been obliged to wait until the patent of Watt ran out in 1800 before he could effect his improvements. Shipping his steam-locomotive to London, he not only took out a patent in which he mentioned

that his engine might be used to run on tram-rails, but in 1802 people were able to view his invention running round an enclosure in what is now Euston Square. Within a high fence through which it was impossible to see, the strange and new horseless vehicle worked, and, by paying a shilling, passengers could enter the carriage and be drawn by the engine round the circular track. This was really the first passenger railway.

Two years later, on February 22, 1804, some onlookers at the Pen-y-Darran Iron Works in Wales witnessed the unfamiliar sight of a steam-locomotive drawing five trucks with seventy men and ten tons of iron along the iron tram-rails whereon trams drawn by horses had been in the habit of running. That was the precursor of the Railway Age, but it was left to George Stephenson to improve on Trevithick's work and give railways to the world.

Trevithick, who went abroad in his disappointment and came home to die in want in London on April 22, 1833, still cherished a regard for his country in spite of that country's scurvy treatment of him. To his friend, Davies Gilbert, the inventor wrote the following sad letter just before his fatal illness :

" I have been branded with folly and madness for attempting what the world calls impossibilities, and even from the great engineer, the late Mr. James Watt, who said to an eminent scientific character still living that I deserved hanging for bringing into use the high-pressure engine. This, so far, has been my reward from the public ; but should this be all, I shall be satisfied by the secret pleasure and laudable pride that I feel in my own breast from having been the instrument of bringing forward and maturing new principles and new arrangements of boundless value to my country. However much I may be straitened in pecuniary circumstances, the great honour of being a useful subject can never be taken from me, which to me far exceeds riches."

That sense of having done his best to help his country

TREVITHICK'S LOCOMOTIVE GIVING PASSENGERS A RIDE ROUND THE ENCLOSURE ON THE WASTE GROUND WHICH IS NOW PARTLY COVERED BY EUSTON STATION. BY PAYMENT OF A SHILLING THE LONDONERS OF THAT AGE WHO WERE BRAVE ENOUGH TO SEEK A NEW THRILL COULD ENJOY A RIDE IN THE FIRST PASSENGER TRAIN! THERE IS A VAST DIFFERENCE BETWEEN THIS OLD PRINT AND THE PHOTOGRAPH OF THE SCOTTISH EXPRESS LEAVING LONDON IN OUR OWN TIME

and his fellow-men was the only comfort left to poor Trevithick in the end.

A little over a century ago, in 1824, there was no such thing as a railway. Poor people, if they went on a journey, were compelled to go on foot, while wealthier people jogged along on horseback or rode in the stage-coach or a chaise. To travel for any distance was such an adventure that the man who set out from London to York, or London to Edinburgh, generally made his will and put all his affairs in order before he took to the road. Delightful as the village smithy and inns and postillions and highwaymen appear to be in novels or on the stage, they were not without their drawbacks in the olden days.

In 1781, at the time of George Stephenson's birth in the mining village of Wylam, near Newcastle-on-Tyne, his father was the engine-minder of a colliery, earning the munificent wage of 12s. a week. Eventually the family grew until six children were compelled to live and eat and sleep with their parents in one tiny, insanitary room with a floor made of beaten clay.

Providing the scantiest of food and clothing was a difficult task on such a small wage as the father earned, and George was sent out as soon as possible to mind the cows of a neighbouring farmer, the shilling a week paid to the boy being a godsend to the home. It was a bigger blessing directly he was old enough to double this wage by doing additional work in the fields. His bent was disclosed by the clay models of engines which he fashioned with his fingers in the marshy places, while mischievous and destructive feet deliberately trampled his handiwork into the earth again.

Unable to read or sign his name, he went at fourteen years of age to help his father attend to the engines at the colliery; but he had the curiosity of youth, which drove him to fiddle about with the engines and explore their works until he knew as much about them as his father, and perhaps a little more. The engines themselves taught him all he knew, but it was another four

or five years before he started to tramp to the nearest village schoolmaster in his spare time to wrestle with reading and writing and arithmetic.

Directly his own weekly wage had grown to 12s. a week he considered it a princely salary. Then, as lads will, he fell in love with a maid on a farm, and he began to repair watches and clocks and boots and do all sorts of jobs in order to save a little money to get married. It is difficult to say whether love or necessity is the greater driving force in life: when they are combined, as they were in Stephenson's case, they spur a man to accomplish almost impossible things. Dealing with the springs and gears of watches and clocks gave him a further knowledge of mechanism that proved of inestimable value in the work he was to do later, and it is worth noting that Henry Ford in our own time, by repairing clocks and watches in his early days, also gained that insight into mechanism which enabled him to make the Ford car one of the cheapest and most popular means of transport to-day.

Married at twenty-one, at which time he was engineman at Willington Ballast Hill, Stephenson lived happily in a two-roomed cottage of his own. Within a year the little cottage echoed to the cry of Stephenson's son Robert, whose mother died three years later. Robert was a great joy to his father, who, feeling his own lack of education, was determined that the boy should not suffer in the same way.

But it was not easy to do what he had in mind. He earned so little money that he was glad to go to a mill in Scotland to attend to an engine of Watt. He tramped home again, to find his father blinded by an accident, whereupon he showed his love and sympathy for his parents in the most practical form by keeping them, as well as his own little son. They lived, like so many families, on the poverty line: it was a bare, mean existence, from hand to mouth.

His sterling character stood him in good stead when the dire call came for him to serve in the Napoleonic

wars. The trifling sum of £6 was demanded to let him off, but he had not got it. He saw only starvation for his parents and son, and perhaps death for himself on a continental battlefield with a French bullet in his body. Anxiously he broached the matter to some friends, and luckily they had such faith in him and his abilities that they lent him the £6 to buy himself out of the army. The world might have waited long for railways had it been otherwise. So distressed and depressed was he by poverty that he considered going to America. In after years he admitted that he wept over it. It was well for Britain that lack of money and family ties chained him to this country.

While Stephenson was at the Wylam Colliery, the owners had acquired one or two locomotives with a view to hauling their trams of coal, but although these were not successful, and one had to be used as a fixed engine, they no doubt proved an interesting study to Stephenson, who was as much influenced by them as Trevithick had been influenced by the model locomotive of Murdock. By 1812, the year that Napoleon was forced to retreat from Moscow, Stephenson, who had been dealing with the engines of the Killingworth Pit for four years, was recognized as a very competent man. Begging the owners of the mine to allow him to build a locomotive for hauling coals, he found to his delight that Lord Ravensworth was willing to provide the money for the purpose.

Remembering the unsuccessful locomotives at the Wylam Colliery, Stephenson set his helpers to work forging and shaping his ideas in metal. The blows of the hammer on the anvil were ringing in a new age. And when, on July 25, 1814, his small, clumsy-looking locomotive puffed along the rails at the bottom of the Killingworth Colliery drawing eight trucks carrying thirty tons of coal at only four miles an hour, Stephenson sensed the glory to come.

Seeing where he could improve his engine, he built another, and then he improved on that. By 1815, the

idea of turning the escaping steam into the chimney of the engine came to him, thus creating a forced draught, and he took out the patent on which practically all steam-locomotives are based to this day. His was the master patent which gave speed to the wheels of the engine, but Gurney always asserted that it was merely an adaptation of his own steam blast.

While striving to improve his engine, Stephenson was also bearing in mind the dangers of the miners, and his brilliant brain invented a safety-lamp quite independently of the better-known lamp of Humphry Davy. This was put into use in 1815, and it brought him in 1818 an award of £1000, without which he probably would not have been able to build his famous " Rocket," his first locomotive to run on a real railway.

In these days it seems rather funny that Edward Pease, planning the first railway from Stockton to Darlington, intended that the trucks full of minerals should be drawn by horses ! He visualized a tramway. Luckily, George Stephenson convinced him that his steam-locomotive was a much more efficient form of traction than horses, and he was appointed as engineer. The labourers began laying the track in 1823, and on September 27, 1825, a locomotive with George Stephenson at the controls stood waiting at Stockton with a train of six trucks loaded with coal and flour, a passenger coach full of directors, twenty-one trucks full of passengers, and six more trucks of coal, while crowds flocked round ready to jeer at the new invention, which they felt sure must prove a failure.

A man on horseback carrying a red flag was to trot in front to warn people to get out of the way, but the speed of the train soon drove him off the track, just as the speed of the first motor-cars drove off the road the man with the red flag who was supposed to march ahead to warn people in the early days of motoring. In less than half an hour Stephenson's locomotive had drawn its load of ninety tons to Darlington at a speed of 15 miles an hour, and upon its return to Stockton some

six hundred people had contrived to pack themselves into the trucks or to hang on in order that they might claim the honour of being among the first to ride on the new railway, so sharing in Stephenson's triumph. For some time after the line was opened, however, the passengers were drawn by horses in a coach greatly resembling a gipsy's caravan, while only the goods were hauled by the locomotive; but the horses were at last banished, and the locomotive remained king of the road.

The proposal to construct a railway from Manchester to Liverpool now aroused the fiercest opposition. It was said that the trains would ruin the countryside, prevent cows from giving milk and hens from laying, while it would make all the land in the neighbourhood of the line near Manchester worthless. Farmers threatened to shoot Stephenson if he passed over their land to survey the route, and the engineer was obliged on one occasion to send a party of men into some woods to fire guns to lure the keepers away. The latter, thinking there were poachers about, rushed off to catch them, and while they were absent the engineer made his survey!

Newspapers urged that the railway should be limited to a speed of 8 or 9 miles an hour, and Stephenson was regarded as mad for saying that he could go at 20 miles an hour. For three days a committee sat in the House of Lords and questioned him. Although he was extremely shy, he knew what he was talking about, and they did not.

"Would it not be very awkward should a cow get on the line if the train went at ten miles an hour?" asked the committee.

"Yes, very awkward—for the coo!" replied Stephenson. He was allowed to build the railway, and his "Rocket," now in the South Kensington Museum in London, beat all other locomotives in open competition, winning a prize of £500 by attaining 32 miles an hour.

Then the steel rails began to stretch out from town

to town, and in seventeen years Britain gained 2100 miles of railways. From 1844 to 1846 people were railway mad. In those three years over 630 companies were formed to build 9500 miles of line, while the public poured money in to support them.

How all the British railways gradually amalgamated as the years went on into the five mighty lines we know to-day, how other countries copied Britain, and clever engineers overcame incredible difficulties to build railways up in the clouds and through mountains and over continents, these are romances which have no place here.

I think of Stephenson trudging to Montrose to work in the mill, and then walking back to find his father blinded through the accident, of the threat to seize him for the army, of his thoughts about emigrating. And the most outstanding thing in his career was his love for his son, their wonderful comradeship, which persisted while life lasted. As the father struggled to educate his boy, the boy in turn passed on his education to his father. While Stephenson set Robert riding every day on a donkey to Newcastle to school, he looked forward to learning at night what his boy had learned during the day. And when the father won that £1000 with his safety-lamp and was able to send Robert to Edinburgh University, Robert taught himself shorthand so that he could write down all the lectures and then read them over to his father. Stephenson was a fine man who sired a fine son, and both were great engineers who left their imprint on the world.

Nor is it in steam railways alone that Britain led the way, for British engineers became the pioneers of all tube and electric underground railways. By building the City and South London Railway in the metropolis, Greathead, who undertook the task of burrowing beneath the city, brought into play his invention of the Greathead shield, which is forced forward into the clay by hydraulic power, and without which the railway could not have been built. The great metal rings of which

The Times

A WONDERFUL NIGHT PHOTOGRAPH OF THE SCOTTISH EXPI[illegible] LEAVING LONDON. THESE ARE THE GIANTS OF STEEL AND STEAM WHICH HAVE GROWN OUT OF GEORGE ST[illegible] LITTLE "ROCKET," NOW IN SOUTH KENSINGTON MUSEUM

the shield is composed protect the labourers from falls of the earth above, compressed air prevents water from percolating in, and directly the men clear the soil away a section of the tube is bolted into place, spaces between the overlying earth and the shield are filled with cement, and the shield is rammed forward again.

The City and South London Railway was opened to the public in 1890, and although it suffered greatly from stuffiness and lack of ventilation, it was of tremendous service to hundreds of thousands of people. Originally it was intended to haul the cars through the tube by a steel rope, but before the railway was finished, electrical science had made such strides that electric traction was adopted, to win another honour for Britain.

Paris has a fine railway running just beneath the surface of the city called the Metro; New York is famed for its subway railways; other cities have solved the problem of transporting their inhabitants in the same way. But all these shallow underground railways were anticipated by the Metropolitan Railway in London, which the engineers started to build in 1853. So great were the difficulties that people thought the line would never be completed. And the cost, too, was beyond all estimates, some of the sections running into £1,000,000 a mile. The idea of an underground railway circling London, known as the Inner Circle, took seventeen years to carry through, and since its electrification it has become one of the quickest and most indispensable methods of travelling about the metropolis.

It is an interesting fact that in London alone during the year 1929 the tramways and omnibuses and underground railways carried over two thousand one hundred and seventy-five millions of passengers. If it were possible to find out and set down the number of people who travelled on all the railways of the earth every year the figures would be so vast that they would convey no more meaning to us than do those rows of figures which indicate the distance of the earth from the farthest star.

A very large part of modern civilization is founded upon the steam-engine and railways, and humanity owes these blessings to the sons of Britain. This in itself is a debt the world can never repay.

There is nothing vainglorious, nothing boastful, in stating the truth.

BRITAIN GAVE THE WORLD STEAM-ENGINES.
BRITAIN GAVE THE WORLD RAILWAYS.

These words should be stamped on every letter that goes through the post, so that the facts would be brought to the notice of all who read.

CHAPTER III

CONCERNING THE SEA

FOR long ages the sea was a barrier between countries and nations. The mighty areas of water stretching over the surface of the earth sufficed to keep men apart. Now those same oceans which separated nations actually bring them together. The seas form one of the finest means of communication in the world, and are thereby of infinite service to mankind.

According to the estimates, to tunnel under the English Channel, a distance of twenty-one miles, would cost £30,000,000, while it is said that a bridge over the Channel would cost more than this sum. Consider for a moment the huge cost, the prodigious labour of such an undertaking. And then try to imagine what it would cost to make a road or bridge from London to New York. Such a road is, of course, somewhat beyond present human accomplishment. It may seem the height of folly even to suggest such a thing, or dream of it.

But by stirring the imagination the infinite benefactions of the ocean may be guessed. Apart from its bountiful harvest of fish which feeds millions every year, it gives us roads from London to New York, to Buenos Ayres, to Sydney, to Cape Town or Bombay.

These islands are a network of roads. We are forced to build roads from town to town and village to village. They are continually wearing out and needing repairs. What their cost has been in labour and money nobody has ever computed.

Yet, in fair weather and foul, the sea provides us with

a universal road, from anywhere to everywhere. It needs no human attention, costs us nothing to keep in repair. We have but to launch our ships on the sea and the road is free for us to choose. And the fullest development of these sea roads was only brought about by the steamship.

Generalizations are easy, but not always accurate. Judging by the large number of Scottish engineers to be found in ships to-day, it would seem that the Scots possess more than the average engineering ability, although James Watt himself thought little of them in this respect. Whether they are actually more mechanically minded than Englishmen is difficult to say. Environment influences a race to a considerable degree. Sunny climes breed lazy races. The climate of England is less rigorous than that of Scotland, the soil is easier to work and more fertile, conditions generally are better, and the edge of necessity which drives men to do things is not quite so keen in the South as it is in the North. The harder conditions in Scotland and the Highlands, with the more severe weather, tend to make the people hardier. Rougher they may be, more unkempt, even more ill-mannered, but they are none the less sincere. The very drawbacks from which they suffer react to their good. They are blessed at birth with no more than average intelligence and brain, but hard living for generations has created that urge to develop the very best that is in them. And their splendid universities are there to help. The result is that in engineering and medicine the discoveries of Scots are of the primest importance. Perhaps all the Scottish engineers who now sail the seas have been unconsciously influenced by the fact that a Scot was the inventor of the steamship. He gave them a lead, and they certainly show no signs yet of relinquishing it.

Intended for the Church, William Symington, who was born at Leadhills in Lanarkshire in October 1763, was a student at the universities of Glasgow and Edinburgh, in which latter city he finished his education.

His father, a miller by trade, loved to dabble with machinery, and it is evident that this interest in mechanics must have been inherited by the son, for instead of going into the Church when he left the university, he obtained a position as mechanic in a Dumfriesshire colliery.

Watt was then building his steam-engines at Birmingham, and Symington himself laboured at a steam-engine which he planned to use, as Murdock had already done, to drive a vehicle along the roads. Chance, however, threw him in the way of Patrick Miller, who was considering the idea of propelling a boat by steam.

The upshot of the meeting was that Miller built a boat, in which Symington set up his engine to work a pair of paddle-wheels, and in October 1787, steam was got up, the paddle-wheels began to turn, and the boat was successfully navigated around the loch in the grounds of Dalswinton House, where Miller lived. Robert Burns, the poet, is said to have witnessed that triumph. About the same time, in America, John Fitch was seeking to propel a little wooden canoe by steam; but he arranged a series of oars on each side like those in a galley of olden days, and although the boat progressed at three miles an hour, his scheme was not practicable. Miller, in selecting paddle-wheels, fixed the method of propulsion which was to serve all the early steamboats, and which continues to serve many steamboats to this day.

Delighted with the success of his first craft, Miller built a larger one, and while this was under construction the Carron Iron Works produced to Symington's design a bigger engine of much greater power to drive the boat through the water. "The machinery, exclusive of the boat, cost £363, 10s. 10d.," wrote Symington. After various adjustments and trials had been made, this steamer attained a speed of 7 miles an hour.

Its great weakness was the method by which the power of the engine was conveyed to the paddle-wheels, which incidentally were placed in the middle of the boat

and not at the sides, as in the later examples. Just as the earliest of our motor-buses had chains to transmit the power of the motor to the wheels, so the earliest steamer was equipped with chains for the same purpose, although the chains were not roller chains such as are used on present-day cycles. The chains on Symington's steamer gave too much play, and set up too much vibration.

Miller, looking at his boat and realizing all its possibilities, could do no more. He felt sure that the method of transmitting the power was wrong, and a discussion with Watt proved so discouraging that he decided to drop the project. It is noteworthy that Watt, the man who gave the world steam-power, was the one who did his best to prevent its use in locomotive and steamer. Symington, however, was not the type of man to give up a thing owing to difficulties. He saw much farther than Miller, his vision was clearer, his inventive faculty not beyond solving the problem which obstructed their progress.

With the enthusiasm of the true inventor, he cast around him until he found a new backer in Lord Dundas. At that time the nobleman was the Governor of the Forth and Clyde Canal; he listened to the inventor, examined Miller's steamer, was quick to appreciate the benefits that would accrue from a steamer that could ply on the canal and tow barges along it. After due consideration he gave the order to Symington to build another steamer.

The inventor jumped to the job. Here was the chance he sought, and he was determined not to let it pass without showing his patron and the world at large that he had invented a motive force of the future.

Calling together a few workmen, Symington set them hard at work constructing the steamer which became known as the *Charlotte Dundas*. He watched the piles of timber gradually take form as the hull, while he employed his inventive faculties on the task of overcoming the chain transmission of power to the paddle-wheels,

eventually succeeding in linking the piston of the engine by a rod directly to the shaft on which the paddle-wheels were mounted.

Instead of the shaft being perfectly straight, it was forged in the centre into the shape of a sort of U. The connecting rod from the piston was fastened to the closed end of the U, and as it moved up and down it gave the shaft a rotary motion which turned the paddle-wheels. Naturally the inventor gave the connecting rod the necessary freedom of movement in attaching it to the piston, and his invention was actually so successful that the main principle still remains unchanged.

The launching of the *Charlotte Dundas* was historic. That little craft, lying at the side of the canal with steam up, was the forerunner of the wonderful *Mauretania* and those other floating palaces which ply the Atlantic, as well as the mighty battleships with which we seek to protect our sea roads and make them safe for ships to bring us essentials in peace and war.

Even Symington could not visualize the wonders that were to spring from his invention, the incredible developments that would take place in a century. As for those around him, they were mostly blind. They were quite content with sailing-ships, so why should they be troubled with this new-fangled invention of steam-ships ? It was just a waste of money and time, and the inventor himself, some critics averred, was only fit for a lunatic asylum. These were the sort of remarks that people made among themselves, and no doubt they believed what they said. They were content to go on in the old way, and they resented being disturbed.

Well, the *Charlotte Dundas* set out with a party aboard in 1802, and her trial trip was a notable success. The passengers were all delighted and astonished, and it seemed extraordinary that they could go in any direction independently of the wind and without being forced to tack.

That was all very well, with a few passengers aboard, said the critics, but would she do real work ?

Symington proved that she would by towing two large lighters full of material in the teeth of half a gale for just under twenty miles in six hours. It was an unprecedented triumph. On the strength of it, and after he had personally assured himself of the ability of the steamer, the Duke of Bridgewater ordered eight of the new steamers from Symington. The inventor's fortune seemed to be made. With such a powerful patron, Symington foresaw the time when sailing-ships would become obsolete.

To his dismay, the Duke died before a single steamer was built. It was a terrible blow. A worse blow followed, for the directors of the Forth and Clyde Canal proved to be exceedingly narrow-minded. They could not see that Symington had opened all the roads of all the seas, that the *Charlotte Dundas* swept away the barbaric age of sail and created a new age of steamships with its infinite possibilities. Their imagination would not soar so high. They were, as they thought, good business men who imagined that the wash of the steamer might damage the canal banks, and if this happened there would be repairs to effect, and repairs, of course, cost money. This attitude would be amusing had it not proved so tragic. They saw disadvantages which did not exist, and were blind to the advantages of the new form of transport.

Calmly they told Symington that they did not propose to make use of the steamer he had built for them. He pleaded with them in vain. They dragged the *Charlotte Dundas* into a creek by the canal, and there the Mother of all Steamships, who ushered in a new era, was allowed to lie until the last of her timbers rotted away.

With the praises of famous men who had taken trips in the steamer still ringing in his ears, but with no money in his pockets, Symington determined to go to London, hoping that he might interest someone there, that perhaps the Admiralty might take up his revolutionary idea and build a warship driven by steam. He tramped down from the North to the City, but instead of

finding a fortune there, he found as the years passed only the direst disappointment. His poverty in 1824 brought him a grant of £100 from the Privy Purse, with a pension of £50 a year, on which he dragged out a weary existence until he died in the capital on March 22, 1831.

If Symington died unrewarded, with his genius unrecognized, we know to-day that it was his work which influenced the world; for Henry Bell, who had learned all he knew from Symington, pushed forward with plans of his own. He also tried to induce the Admiralty to adopt steam propulsion, and failed. Going away, he returned another day, after he had succeeded in interesting Lord Nelson in his project. Even the backing of Nelson was not sufficient to gain the favour of My Lords of the Admiralty. Sir Joseph Banks admitted the possibilities, but denied the practicability of the plan; yet the *Charlotte Dundas* was at that moment lying by a Scottish canal to prove that he was wrong. So Bell went North again and built the thirty-ton *Comet*, which was driven by a 3 horse-power engine of his own, and carried passengers between Glasgow and Greenock for eight years.

As for Robert Fulton, he had been all over Symington's steamer; the inventor himself got up steam and took him for a special trip in order to explain everything to him quite frankly while the engine was working, and if the directors of the canal were blind, Fulton was not, for he seized at once on the possibilities. He also went over Bell's plans; then, ordering from Boulton and Watt at Birmingham one of Watt's steam-engines to be shipped to America, Fulton returned home and built the *Clermont*, which made a most successful trial in August 1807. In three days it steamed 300 miles, its speed being a steady 5 miles an hour, whereas Symington's steamer made $7\frac{1}{2}$ miles an hour.

John Fitch, who gave up the idea of propelling his boat by oars and adopted paddle-wheels two years after Symington, died like him in absolute poverty and misery, whereas Fulton and Bell were acclaimed. Not content

with reaping a rich reward from the Scotsman's invention, the sharp American even tried to steal all the credit for it.

In his rare paper on the steamship, Symington blows the American claim to smithereens by writing: "Mr. Fulton asked me if I had any objection to his taking notes regarding the form, the size, the construction, etc., of the steamboat and steam apparatus; to which I answered that I had none, as I was of opinion the greater publicity that could be given to a discovery intended for general good so much the better. He accordingly took out a memorandum book and put several pointed questions to me . . . and noted down the answers."

Symington had the bitter experience of seeing Fulton take his idea across the Atlantic and win renown; he watched Bell's reputation grow as the *Comet* steamed up and down the Clyde. Perhaps in the circumstances death was a happy release. Time has swept away many reputations since those days, but the glory of Symington grows greater as the years roll on. Other men experimented, but the visionary Scotsman gave us the steamer in a practical form.

While Symington was already struggling with his wooden steamer, others were actually making experiments which were destined to revolutionize the ancient trade of shipbuilding. The craftsman who built ships right from the dim ages up to the middle of the nineteenth century was a carpenter. "Hearts of Oak" were our ships in reality, and the forests of England were felled to create and build the King's Navy and those barques and clippers which lent grace and beauty to the sea in olden days.

Despite the great age attained by some wooden ships, a fast clipper could not maintain her position as Queen of the Seas and bring her cargoes home in record time for much longer than ten or twelve years. When steam-engines were mounted in wooden ships to drive them with paddles, the wear and tear was such that their life was materially shortened, and the repairs proved very

costly. If something more durable than wood could be discovered out of which to make steamships, the gain to humanity would be very great. And what was more durable than iron ?

The first men to broach the subject of building iron ships were met with shouts of ribald laughter. Shipwrights jeered at them and regarded the idea as one of the greatest jokes ever made.

" Fancy thinking iron would float ! " they laughed.

Thomas Wilson, who was building the iron *Vulcan* for passenger service in 1817, told them to throw their beer cans into the canal and see.

Probably the very first iron boat was launched on the River Foss in Yorkshire in 1776, though little is known about it. There is no such haziness about John Wilkinson's iron canal barge, which he launched eleven years later. Wilkinson, a Lancashire ironfounder, built his boat, which was 70 feet long, of riveted iron plates, and she weighed eight tons, proving her ability on the first trip by carrying twenty-three tons of iron to Birmingham.

Wilson, who built the first iron passenger boat, was a carpenter, and he got a blacksmith to help him in the work. She was 61 feet long, and she carried passengers up and down the Forth and Clyde Canal, whose directors had crushed Symington's hopes and whose waters ate away the timbers of the first steamer. These two men, a carpenter and blacksmith who toiled away with their own hands at creating that small boat, were the founders of the mighty shipbuilding industry on the Clyde. although neither dreamed what an astounding change their work would bring about in that peaceful valley in the course of a hundred years, of the great shipyards and wharves and docks that would be constructed for the steel ships of the future.

The *Vulcan* had solved the problem of rotting timbers, and Symington had solved the problem of propelling a wooden steamer by machinery. It remained for Aaron Manby, of the Horsley Iron Works, Staffordshire, to wed these two ideas and give to the world the

first iron steamer. The *Aaron Manby* had a breadth of 18 feet and a length of 120 feet, while her paddle-wheels were driven by engines of 80 horse-power. She was built in sections in the Staffordshire ironworks, and in sections she reached the banks of the Thames, where her plates were riveted together. The skill and courage and foresight of the ironfounder were amply rewarded by the success of his revolutionary cargo boat, which aroused the greatest excitement in London, and brought all Paris crowding to the banks of the Seine in 1821 to watch her steaming up the river with her cargo. She was the forerunner of all the mighty liners and cargo-carriers and warships of to-day.

So revolutionary was she that there was no great rush to build ships like her, but she carried her cargoes with such regularity, and her cost of upkeep was so small and her life so much longer when compared with the wooden vessels, that a few men at last ventured to copy her. By the time she was thirty years old, and still giving good service, one British ship out of five was built of iron. The small proportion indicates that if the shipbuilders and owners had not yet realized the wonderful possibilities of iron ships, the pioneers were quietly making ready for the revolution. It came between the years 1850 and 1860. Shipowners, who had previously been wedded to wooden ships and sails, began to clamour for iron steamships. In those ten years five wooden ships out of six were scrapped and replaced by iron steamers. It was an extraordinary change to effect in such a short time, and it led to big developments in our ironfoundries and shipyards.

While the men who believed in iron ships were struggling to victory, one or two men were fighting hard to bring about the introduction of the screw-propeller in place of the paddle-wheel as a means of propulsion. So long ago was the idea of the screw-propeller first utilized by the Chinese that the name of the true inventor will never be known, and although John Stevens tried a propeller in 1802 in America his experiments proved a

failure. Indeed, the names of men who were attracted to the problem of propelling a vessel by means of a screw were numerous ; an Austrian, Ressel, took out a patent for a screw in 1812, and his invention successfully propelled a steamer seventeen years later, but the inventor or his propeller apparently lacked sufficient driving-force to interest shipowners.

Grateful as the world must always be to the man who conceives a great idea, it may owe considerably more to the man who turns the idea into a practical form and gives humanity the benefit of it. For the screw-propeller humanity may thank two men—Ericsson, a Swede who was attracted to England by the sudden rise of our engineering genius, and Sir Francis Smith, who began life as a farmer.

It was Ericsson who first went to the British Admiralty to try to introduce the screw-propeller into the Navy. But although Ericsson induced some of the Lords of the Admiralty to go aboard his boat and see for themselves, the Admiralty would have none of the new-fangled notion, notwithstanding that it was clearly better than paddle-wheels. The objections they discovered were ludicrous. It seemed that the paddle-wheel was the height of perfection, that no one could steer a ship fitted with a screw—although Ericsson had already steered his ship well and shown she was under perfect control when My Lords were aboard—these were some of the arguments with which Ericsson was turned away and driven to America, where he received much better treatment, and his ideas were carried into effect.

Nevertheless, it was not due to Ericsson that the British Admiralty were driven to adopt the new idea, although they later awarded the Swede the sum of £4000 as his share in bringing the invention to their notice. As Smith or his backers received £16,000, the figures may give some idea of the credit which was considered to be due to each man when all the facts were duly considered.

Francis Pettit Smith found himself in his early

twenties farming at Hendon on the outskirts of London. His mind one day began to puzzle over the idea of the screw-propeller, and as he was in the neighbourhood of that fairly large expanse of water known as the Welsh Harp he was able to experiment. In 1835 a little boat propelled by a screw, which in turn derived its power from a strong spring, might have been seen moving over the water. It worked well, but not well enough to please the inventor, who straightway set about improving on his first model. His second worked even better, and he saw in that little craft moving over the waters of the Welsh Harp the propelling force of the future for all ships.

Other men, unfortunately, were not blessed with his foresight. In 1836 he patented his screw-propeller—six weeks before Ericsson took out a patent—and within a few months found one or two men to back his invention. A little ten-tonner was built and fitted with his screw, which incidentally was made of wood and had a double twist in the blades. A steam-engine of 6 horse-power actuated the screw, and the craft forged ahead and answered to the helm perfectly. The great drawback to her was that she was slow.

Smith was plugging ahead in her one day when he felt a bump. Immediately after the bump the craft started to go ahead much faster. Surprised at the sudden access of speed, he stopped her to see what had happened, and found that the screw had hit a floating bit of wreckage which had knocked off one of the twists in it. Quick to realize the providential nature of the accident, Smith cut down the size of the blades and found the screw much more efficient !

He laid siege to My Lords of the Admiralty, who were not disposed to listen to him at all. In dismissing Ericsson they hoped they had seen the last of these troublesome inventors, but Smith was not the type of man to be easily discouraged. He felt that he was right, and he had the persistence to force his idea on them.

" If you could produce a boat with a speed of five

knots we might be disposed to listen," the Admiralty told him. They thought it was impossible. He did not. He got friends to find the capital, and they built the *Archimedes*, named after the old Greek who invented the archimedean screw, on which the screw-propeller was really based. She was not a large craft, as ships go to-day, only 237 tons, with engines of 80 horse-power, but she achieved a speed of ten knots, and the Admiralty was obliged to take notice. No doubt some of his opponents wished Smith and his ship at the bottom of the sea, but Smith did not mind. His ship went on an extended cruise with the experts, steaming round our coast, making her way to the Continent and as far as Portugal and back.

I am afraid that My Lords regarded the *Archimedes* as rather a nuisance and hoped she would never return. When she came back to England they decided to think the matter over—which took a long time. But eventually they gave in to the persistent Smith and his backers and began to build the *Rattler* of 900 tons with a screw-propeller. The building dawdled on, the opponents probably hoping she would never be completed. But at last she came off the stocks, and although she came well through her tests, the narrow-minded men who were still wedded to paddle-wheels remained unconvinced. Then was arranged the strangest tug-of-war in all history, the *Rattler* and the paddle-wheel vessel *Alecto* being set to pull against each other. The paddle-wheels of the *Alecto* churned up the water furiously, smoke poured out of her funnels, but the *Rattler* began to forge ahead and calmly towed the struggling craft back into harbour as though it were only a dinghy.

The fight for the screw-propeller was won, but it had cost Smith's backers a fortune of £50,000, and the inventor himself was practically penniless. However, the Navy ordered twenty ships to be fitted with the screw, and the inventor was busy for a time. But eventually his straitened circumstances compelled him to take up farming again. A tardy award of £200 a year,

followed by a Government appointment as a curator at South Kensington, relieved him of want, while a few men who realized the blessing he had given to the world subscribed just over £2000 for him. Over twenty years after he had forced the Admiralty to take up the screw-propeller he was knighted, and a few years later, in 1874, he died at South Kensington.

The way of the inventor is indeed set with disappointment, and it all too frequently happens that where one man invents, another reaps the reward. Many years before Smith became interested in the screw-propeller, which was in 1835, a young Scot, Robert Wilson of Dunbar, was intrigued by the same problem. Observing how unmanageable paddle-wheels rendered a steamer in a rough sea, Wilson, who knew well how to scull a boat with one scull from the stern, in the old-fashioned way, concluded that an adaptation of this method would make a ship much handier in bad weather. He was quite unable to work out his idea, however, until one day he came across a windmill with four sails gaily working. Realizing that he had only to arrange his four sculls in a like order in order to propel a ship, he made experiments with various models fitted with two, three, and four propeller blades.

So successful was he, that the Society of Arts for Scotland tested one of his clockwork models on the sea at Leith in June 1832, and awarded him their silver medal for his valuable invention. Then the Society forwarded details of the invention with the clockwork machinery and propeller to the Admiralty in London, " with a strong recommendation," and consideration of the invention was deferred to officials at Woolwich. Somebody blundered or else was incompetent, for the invention was duly rejected in a letter from the Admiralty on September 17, 1833, in which it was stated : " The plan proposed (independent of practical difficulties) is objectionable, as it involves a greater loss of power than the common mode of applying wheels to the side."

TWO BRITISH MASTERPIECES, THE MAURETANIA IN THE SOLENT AND ONE OF THE SCHNEIDER TROPHY SEAPLANES TAKING THE WATER IN THE FOREGROUND. AFTER HOLDING THE ATLANTIC RECORD FOR TWENTY YEARS, THE MAURETANIA IN HER OLD AGE LEVELLED HER OWN RECORDS AND ONLY JUST FAILED BY THE NARROW MARGIN OF $3\frac{1}{4}$ HOURS TO EQUAL THE RECORD OF THE NEWLY-BUILT GERMAN SHIP. SHE IS REGARDED BY EXPERTS AS THE WORLD'S WONDER SHIP, BUT THE NEW SECRET CUNARDERS WILL OUTVIE IN SIZE AND SPEED EVERY LINER AFLOAT

Twelve years later the Admiralty accepted Smith's propeller, and one of the officials who reported favourably was the very man who had condemned the identical invention of Wilson. I have gone into the matter carefully, and there is no doubt on this point. Wilson, who was too poor to patent his invention, was driven to drop it, whereas Smith, owing to the financial strength of his backers, was able to impose it upon the blind-eyed officials.

France wrought the change from iron ships to steel ships, but Britain with her great deposits of coal and iron and the newly invented methods for making cast-steel quickly led the way and built steel ships for the whole world. British steel ships were better and cheaper than those of any other nation, while the British engines were of finer workmanship and less liable to break down.

It seems but yesterday that I was reading of the unprecedented success of a new torpedo-boat destroyer, H.M.S. *Viper*, which attained the high speed of 36½ knots or 42 miles an hour on trial, thanks to an entirely new type of engine with which she was fitted. This engine was the Parsons turbine, and Sir Charles Parsons, as he now is, after building the steam yacht *Turbinia* to show what his new engine could do, amazed the Admiralty experts with the *Viper*, and gave the world a new and revolutionary method of using steam-power. Instead of setting the steam to drive pistons up and down, he set the steam impinging on ever so many little blades arranged at a certain angle round a central shaft. The force of the steam driving against these blades gave the shaft a direct rotary motion, and it was no longer necessary to lose power by changing an up-and-down motion of the piston into a rotary motion.

Sir Charles, who fortunately is still alive, was born in the metropolis on June 13, 1854. Thanks to his father, the Earl of Rosse, who was a noted astronomer, he became very interested in science as well as mechanics, and after studying at Dublin University and Cambridge University, where he took the degree of M.A., he went to

the Armstrong Engineering Works at Elswick as an apprentice for three years, one or two minor inventions leading up to his great invention of the turbine.

Initial experiments gave encouraging results. The first turbine, which he produced in 1884, was only of 10 horse-power, and the amusing thing is that the engine, designed to save steam, was about the biggest steam-waster ever constructed. The shaft spun round at an unheard-of pace, 18,000 revolutions a minute, so fast that its very speed was one of its biggest drawbacks, since there was then nothing in existence which would allow this terrific speed to be utilized. Once set on the path, however, Sir Charles was not to be turned aside. Problem after problem he solved, until he made his steam-turbine into the most economical and efficient steam-engine the world has ever known.

To-day the power of the turbine propels the fastest liners and mightiest battleships, and similar turbines, driven by water-power or steam, are the creators of most of the electrical force which helps to drive the modern world. To say that Sir Charles Parsons invented the most efficient steam-engine that ever worked for man is the literal truth.

While it is impossible for me even to mention all the minor inventions in connection with ships and ship-building, I feel it would be ungenerous not to bestow a word of praise on Germany for the invention of the Diesel oil-engine, with which so many ships are now being equipped. The steam-turbine and the heavy oil-engines are competing fiercely for places in the engine-rooms of ships of to-day, and it is an open question whether oil or coal, oil-engines or steam-turbines, will be used for developing the electricity for driving the ships of to-morrow.

There is, however, one development in connection with ships of which all Britons should be proud. The most beneficent measure ever adopted for ensuring the safety of all who travel on the seas was the life-work of an Englishman, Samuel Plimsoll. In bygone days some

shipowners were not above overloading their ships, with the result that many a ship has been lost with all her crew. Sometimes the ships themselves have been utterly unseaworthy, and it has been little short of murder to send them to sea at all. Quite apart from the instances where old craft have been deliberately insured beyond their value and then scuttled, there are the cases where captains have taken more freight than the ship would hold so as to make a highly profitable trip.

Plimsoll took it upon himself to fight for the seamen, who had no choice in the matter. Once aboard, they were forced to obey orders or run the risk of being put in irons and charged with mutiny if and when they reached port.

Plimsoll brought the matter up in Parliament. For years he agitated. He suffered several defeats and caused one or two bitter scenes in the House of Commons before an Act was passed in 1875 making a load-line compulsory on all British ships. Other nations have gradually followed Britain's lead, and after the lapse of half a century the United States have brought into force a similar law.

To-day, if you wander down by the docks, you may see on the sides of ships circles about the size of a dinner-plate painted in white with a black line running across the centre. That is the Plimsoll mark ; the black line indicates the water-level when the ship is fully loaded, and no captain dare ignore that mark except at the risk of losing his certificate if anything unfortunate should happen.

Just a mark on the side of a ship ! Lacking it, men may drown ; with it, men may sail the seas in safety. Could anything be more simple ? That simple mark is the finest monument any man could wish for ; it indicates that one Briton at least thought more of human lives than profits. In fighting the cause of British seamen he was fighting the cause of humanity.

If there be some people who are inclined to say that these were the triumphs of yester-year, and that British

hands have now lost their cunning and industry, I would remind them that there is no present indication of the truth of their remarks. In the period before the Great War afflicted the world, British shipyards built 60 per cent. of the world's ships. In 1929, despite grave difficulties, our shipbuilders managed to produce 51 per cent. of the world's new ships—figures which show that Britain can even now build the best ships, and that she is doing so !

The old spirit still survives, as Sir Henry Segrave proved. The victory of his motor-boat, *Miss England*, at Venice in September 1929 left him unsatisfied, for his average speed of over 92 miles an hour failed to break the American record. Quietly Mr. Fred Scott, the designer of *Miss England*, designed a faster boat, Rolls-Royce equipped her with wonder engines of a new light alloy, and on that unlucky Friday, June 13, 1930, Sir Henry Segrave set *Miss England II.* scudding like the wind over Lake Windermere.

Up and down the course he went in safety. His stop-watch told him that America was vanquished. He clapped his engineer, Mr. M. J. Wilcocks, on the shoulder as they completed the second mile.

" Beaten the record ? " shouted Wilcocks above the roaring engines.

Sir Henry nodded delightedly.

They turned for the third trial. The boat leapt forward faster than ever. This time came disaster. Just a small branch floating on the water ! A touch, while the boat was rushing at over 100 miles an hour, and half the wooden step was stripped from the bottom, leaving her as unbalanced as a motor-car with both side wheels off. A second later she was upside down. Mr. P. V. C. Halliwell was dead of a broken neck, Segrave shattered beyond recovery. Perhaps if the step had been armoured, the catastrophe would have been avoided. Who knows ?

Segrave was aware of the risk—he once stated that striking a fish at full speed might bring about his death

—but he faced it calmly. His whole soul was bent on wresting the motor-boat speed record from America, and before he died of his injuries he learned from the official time-keepers that he had triumphed. His average speed, afterwards confirmed by the International Motor-Yachting Union as the world's record, was 98·7 miles an hour.

To those thousands of people, reading of the tragedy, who asked themselves what useful end was served, whether it was worth while sacrificing two gallant lives for such a purpose, *The Times* in a leader on Sir Henry Segrave next day gave answer : " It has yet to be shown that humanity is any the better for the speed in movement which the experiments and the achievements of a Segrave put within its reach. But, if speed is nothing, the spirit that urged Segrave to speed is a great and noble thing. It is the spirit of adventure, of courage, of honourable emulation, which, however useless its objects may be, is in itself a higher thing than that which would suffer human life to drag listlessly on in grooves of habit and of indifference. By his courage, his determination, his vitality, his devotion to an end, Sir Henry Segrave set an example to all. A man of genius in his own field, he must be counted among those who have deserved well of their kind, and his name will be remembered in honour."

Sir Henry Segrave, in seeking speed, aimed at something more than speed, for in his mind he visioned a new type of ship which might spring from *Miss England*, a ship which could skim along on the surface at speeds which would make the fastest ships now afloat seem like slow tramp steamers by comparison. The future will reveal if he was right.

Such courage as he possessed, such genius as the designers of craft and engines displayed, are the very core of our greatness. Britain's sea-power is no nebulous fancy ; it remains a force to be reckoned with. And those who face the coming years with apprehension may console themselves that we are still in these days rearing

leaders of men, and that the British courage and genius which alone were responsible for changing the wooden ships of last century into those wonderful floating cities, with their shops and cinemas and newspapers, which sail the oceans of the world to-day, are not yet lost to the British race.

CHAPTER IV

TRIUMPHS OF ROAD AND AIR

A CENTURY ago traffic began to desert the roads for the railways, yet in our own time the Wheel of Life has turned completely round. Traffic is now flocking back to the roads in an ever-increasing volume ; the railways, which have enjoyed a long monopoly, are beginning to suffer so much that they are compelled to devise means of facing the growing competition of the motor vehicle.

Gone are the days of the slow-moving, horse-drawn vehicle ; no longer does the merry call of the coachman and the rattle of the horses' hoofs warn the villagers of the coming of the four-in-hand. The scarlet coats, the jangling harness, the cries of the ostlers as they change horses at the inn, or rush out with pails of water to give the steaming animals a drink, these are things of the past. In place of them we have cars gliding along the roads faster than the trains on the railways, with 60 miles an hour as an ordinary speed. Indeed, I have vivid recollections of being driven on a very dark night along a continental road with the needle of the speedometer creeping up to 100 miles an hour, while the trees at the sides appeared as an impenetrable fence under the dazzling headlights.

With the present century came the Motor Age, and the rush of Man along the roads in his mechanical carriage was followed quickly by Man's flight through the air. Motor-cars and aeroplanes and airships seem scarcely born, yet so familiar are they that the miracle of them is already forgotten. How, then, does Britain stand in this new age ? Does she still point the way

to the nations, or is she content to follow where others lead? The facts must speak for themselves, and by them Britain is content to be judged.

It seems almost in the dark ages that Richard Trevithick and his friend in that first crude steam-carriage puffed up to a toll-gate on a black night in 1801 and called for the gate-keeper to open and let them through. And when the terrified man saw the sparks flying from the engine and heard the noise of it he thought the machine was from the infernal regions, manned by two devils.

"How much?" called Trevithick.

"Nothing—from you!" the poor wretch whimpered, hoping to propitiate such a terrible pair!

The toll-gate that hindered Trevithick on his first ride symbolized the forces which robbed the world of mechanical road transport for nearly a century. The owners of the toll-gates were far too rapacious towards mechanical vehicles. Within a few years of the opening of the first railway, several companies were formed to run steam vehicles along the roads. But the demands of the toll-gates frustrated all attempts to inaugurate the era of the horseless carriage.

One of the foremost pioneers was the Cornishman who afterwards became known as Sir Goldsworthy Gurney. A contemporary of Murdock and Trevithick, he spent his earlier years in studying medicine and surgery, but the idea of mechanical traction so appealed to him that he devoted his time to solving the problem. In order to get up a head of steam quickly, he designed the first water-tube boiler for his engine, and in 1827 he piloted a steam-coach about the roads with twenty people aboard; it was built to a design which he patented in 1825, using coke in the furnace and a forced draught to overcome the nuisance created by the smoke from coal. Improvements quickly followed and were embodied in new coaches, one of which went in 1829 from London to Bath and back at over 10 miles an hour, notwithstanding that a part of the engine

broke down and Gurney was also manhandled on the way by ignorant peasants, who hated these Satanic contrivances!

Adapting one of his steam-coaches for running on rails, in 1830 he lit the fire in the furnace and raised steam in 4½ minutes, afterwards hauling a load of about 20 tons, composed of six cars and a hundred persons, for 3 miles in 39 minutes. Altogether he and his friends spent £30,000 in trying to develop steam-traction on the roads, and in 1831 they presented a petition to the House of Commons on which a Select Committee sat. The power of the turnpike owners was crippling, as is proved by the committee's report to the House:

"Tolls to an amount which would utterly prohibit the introduction of steam-carriages have been imposed on some roads," they reported. "Two causes may be assigned for the imposition of such excessive tolls upon steam-carriages. The first, a determination on the part of the trustees to obstruct as much as possible the use of steam as a propelling power; the second, . . . a misapprehension of their weight and effect on the road." Some of the tolls imposed were cited: "On the Liverpool and Prescot road Mr. Gurney's carriage would be charged £2, 8s., while a loaded stage-coach would pay only 4s. On the Bathgate road the same carriage would be charged £1, 7s. 1d., while a coach drawn by four horses would pay 5s. On the Ashburnham and Totnes road Mr. Gurney would have to pay £2, while a coach drawn by four horses would be charged only 3s. On the Teignmouth and Dawlish roads the proportion is 12s. to 2s." The committee frankly termed such tolls exorbitant, as they were, for it was impossible for steam-coaches to pay tolls twelve times as much as ordinary coaches and show a profit.

Yet Londoners may be proud to know that steam-buses were actually running in London so long ago as 1833, plying from Paddington to the City Road and London Wall and back again two or three times a day. Just as the drivers of horse vehicles used to get on the

rails and obstruct the first electric tramcars, so horse drivers used to hinder the steam-bus. The inventor of these steam-omnibuses was Hancock, whose vehicles in 1836 covered 4700 miles between Paddington and the city. In a demonstration he carried seventy people along the Bow road for a mile at 21 miles an hour, making a trip with a full coach to Romford and back at over 10 miles an hour. Once he took his bus and put it through all sorts of evolutions outside the Guildhall; on another occasion he met the Lord Mayor going to hold a court at Stratford, and proudly drove at the head of the procession. When the Stratford Cricket Club had a match at Epping Forest, Hancock arranged to take twenty-two of the members to the venue, but thirty-seven of them squeezed into the steam-coach, and he drove them to Epping at 15 miles an hour. As was only to be expected, the steam-coach aroused considerably more interest among the members of the two teams than did the match which they played. But after fighting to inaugurate the New Era for sixteen years, during which time he developed a very efficient type of steam-omnibus, Hancock was beaten.

A second petition to Parliament was presented by Gurney, and supported by the Chairman of the first Select Committee. But a Bill to Regulate Tolls, which was passed by the House of Commons, was thrown out by the House of Lords, and steam-coach services became an impossibility. So strong was the opposition by various vested interests, such as the old coaching companies and toll-gate owners, and such force did it gather as the years went on, that the Government was eventually prevailed upon to pass an Act regulating the speed of any mechanically propelled vehicle on the roads to 4 miles an hour, and making it compulsory for a man with a red flag to walk in front of the vehicle. This Act not only precluded the development of steam vehicles for the roads, but it prevented very efficient steam vehicles already in existence from working, and proved one of the strongest barriers to the early motor-

cars. Not until 1896 was it abolished, and the way made clear for the motor-car to travel, without a man with a red flag, at 12 miles an hour! But for the crass stupidity and cupidity of our forefathers, the steam-car might have developed wonderfully during the years that this Act stifled all progress.

Probably one of the most brilliant intellects of all time was that of Roger Bacon who, studying in Oxford and Paris, returned to his beloved England and settled at the former place, where he became a monk in 1240. Blessed with the brain of a seer, in those far-off days of the thirteenth century he peered into the future and made the most marvellous prophecy, which has been fulfilled to the letter after the lapse of more than six centuries. "We will be able to construct machines," he wrote, "which will propel ships with greater speed than a whole garrison of rowers, and which will need only one pilot to guide them. We will be able to propel carriages with incredible speed without the assistance of an animal. And we will be able to make machines which by means of wings will enable us to fly like birds."

Symington helped to bring the first to pass; Trevithick made the second part of Bacon's prophecy come true by his invention of the steam passenger coach; but the honour of inventing the motor-car is hotly contested by several continental countries. Austria, for instance, has erected a monument to Siegfried Markus, who showed at the Vienna Exhibition of 1873 a benzine-driven motor-engine, which opponents assert never really propelled a vehicle; they may be wrong, or they may be right. Then France claims that Etienne Lenoir, with an engine that was run on a mixture of gas and air, and exploded by electric sparks, was really the true inventor of the motor-car; while Germany puts forward two claimants in Karl Benz and Gottlieb Daimler.

Leaving these countries to settle the matter among themselves, I may state that the foremost engineers in the motor world by common consent honour Gottlieb

Daimler for being the Father of the first internal combustion engine, which made the Motor Age and the Flying Age possible. The German himself, full of admiration for British machinery, was glad to work in Britain to gain as much experience as he could. British engineers have always been willing to teach foreigners who were willing to learn, and they have proved such efficient teachers, giving so generously of their knowledge, that the present difficult times are in some measure due to this cause.

It was in 1883 that Daimler, who was born in Würtemberg in 1834, was inspired to produce a new type of internal combustion engine. For years he had been making gas-engines with Dr. Otto, and he saw that it might be possible to base an engine on the same design, in which gas could be produced by volatile spirit and the engine used to propel a vehicle along the roads. Daimler succeeded in building his first little one-cylinder engine and fitted it to a tricycle which bore him easily about the streets without his having to use his legs to pedal. He had every reason to be a proud man, for he had given the world a new form of transport, and all the motor-cars in existence to-day spring from that motor-cycle of the German.

After extended trials he built an improved engine, the French rights of which were bought by Levassor. That engine seemed to stimulate the inventive faculties of many men, especially in France and Germany. Steam-cars, electric-cars, motor-cars, inventors worked feverishly at their particular designs and theories, and with steam-cars which in a few years attained a speed of 60 miles an hour, motor-cars that dashed about noisily, and electric-cars that glided silently and smoothly, it was not easy to see which would finally emerge as the favourite form of mechanical road transport.

In those early years Britain was holding aloof, with an obsolete Act that barred proper trials on the roads, and F. H. Royce was developing his brilliant talents by making electrical cranes in Manchester. The son of a

miller, Royce was born in 1863 at a little place called Alwalton, near Peterborough, and the wolf was never far from the door of that humble cottage. When death swept his father into the grave, the struggle for existence, if it was stern before, became desperate. Education, in its accepted sense, went by the board. The Education Acts had in those days barely begun to function, and the boy picked up a smattering of knowledge when and how he could.

Forced to put his shoulder to the wheel, in order to help his mother, the boy of ten was glad to earn a few coppers by delivering papers for W. H. Smith & Sons. Then for a time he got a little schooling, and at the age of thirteen became a telegraph boy in the Post Office. After spending a year knocking at doors with telegrams, Fate tipped the balance in his favour by bringing him an apprenticeship at the Great Northern Railway's repair shops at Doncaster. For four years he revelled in engines and learned to take a pride in good work and appraise a first-class job. Then circumstances compelled him to quit before he could finish his apprenticeship, and with glowing recommendations from his chief in his pocket, he went to Leeds to look for a job in which he could earn some money. If Fate had been less harsh, Royce might have finished his apprenticeship and remained in the service of the railway—and the world might never have enjoyed the Rolls-Royce car !

For a fortnight he searched Leeds for a job, before being taken on by the Italian Arsenal, where for months in 1881 he worked for sixteen hours a day and all night on Fridays. A post as tester to Edison & Swan, who were experimenting with electric light, brought him to London, where he found time in the evening to study under Professor Ayrton in Finsbury, and after studying and working hard for a year he was offered the appointment of chief electrician to the Liverpool branch of the Electric Light and Power Company. He was one of those engineering geniuses whom England breeds now and again, to add to her greatness. He hated to waste

time ; he was far happier when he was busy ; and it is part of his creed that if a man has time to spare, it is as well to do something useful with it.

Saving money, he was able when the Liverpool company closed down to start for himself in Manchester. And the electric cranes he made were just as perfect as he could build them. But the market was far too small, and foreign competition much too severe, to make a fortune out of cranes. Nevertheless, he was able to afford a small French car, which he amused himself by taking to pieces during the week to see how the motor functioned, and putting it together again in time to get on the roads with it during the week-ends.

Here was a new sphere in which he could exercise his abilities, with prospects that were almost dazzling. He had no doubt in his own mind that he could create a better car than the French car, and in 1903 Manchester knew that Royce was willing to repair any car that would not work. It was an ideal way of finding out the weaknesses of the existing cars, and when he had reviewed the cars as they were, he set about designing his car as it should be.

The building of the first car was a labour of love. Royce himself spent hours and hours machining various parts, setting his mechanics the degree of perfection he had in mind. One thing only would content him—the very best.

" It's good enough ! " a mechanic said one day, after working at a part which certainly looked good enough to be passed by most people.

Royce heard, and by the time he had finished telling his mechanic what he thought about it, the mechanic realized that nothing short of perfection was good enough for the Royce car. The inventor sought to make his car safe, speedy, and economical, and when his first car was almost built he discovered to his anger that someone had bent the front axle slightly to make it accord with his design. Once more Mr. Royce flayed the mechanics with words, pointing out the iniquity and

danger of such a foul practice which might easily cost a man his life.

By the early months of 1904, Royce completed his first three experimental cars of 10 horse-power and put them on the road. One was for the use of Mr. Claremont, the Chairman of Royce Ltd., to make business calls—and he thought it always prudent to have a hansom cab following the car in case it should break down! And in the car itself, with an impish sense of humour, he fixed a plate saying: "If the car breaks down, please do not ask a lot of silly questions!" Occasionally a car broke down some distance away and had to be left by the roadside all night, but that was of small moment in those days, when breakdowns often led to the most amusing scenes. The pioneers of motoring never knew when they were going to be blown up or pitched into a ditch, and I recollect an owner who, after fighting for a long time to get his car to go, at last gave up in high dudgeon and made a present of it to a startled bystander!

By sheer engineering genius, which has at last received the recognition of a knighthood, Sir Henry Royce made the Rolls-Royce car the finest in the world. Motor engineers everywhere are agreed on this point. There is nothing to touch it. It is British and Best, and it has triumphed since the beginning because of the high quality of its work and the brilliance of its design.

Many were the thrills in the early days of motor-buses, for the ladies regarded the young bloods who ventured on the new vehicles as most foolhardy. Incidentally the bold young buccaneers soon learnt their lesson—not to pay their fares until they got to the end of their journeys, for if the motor-bus broke down their fares were paid, and they had to pay again to the next bus that came along. Many a smile was raised by the sarcastic remarks and ribaldry of the drivers of the horse-buses when they came across a stranded motor-bus on the road with a little bevy of disconsolate passengers about it. They roasted passengers, motor-

bus driver, and conductor indiscriminately, and were delirious with joy if their horse-bus was full up and they had no room for the stranded ones.

The mention of motor-omnibuses reminds me that in this field London also led the way and taught all other nations that heavy motor vehicles could be developed into an efficient means of transporting the passengers of large cities. Incidentally the London General Omnibus Company was the first passenger transport concern to adopt the shaft or cardan drive instead of the chain drive over the wheels, which swept away one of the biggest drawbacks to this form of heavy motor traction and performed a service that cannot be praised too highly. When I think of the first motor-omnibus in which I rode—the rattling noises and vibration, the crash of changing gear, the smell—and compare it with one of the latest six-wheeled buses fitted with pneumatic tyres and comfortable seats, buses of 95 horse-power that carry sixty passengers and stop and accelerate and glide along with the speed and smoothness and ease of a private car, I am amazed at the progress made in so few years.

"The world is on wheels and always will be," said Mr. Henry Ford, although no one can say what developments may take place in the air in the future. Nevertheless, all will agree that wheels serve the world very well at present, but it is only right to point out that they serve the world so well and have been able to multiply in their millions largely owing to British ingenuity.

The greatest factors in the development of the motor-car were first of all the internal combustion engine and, secondly, the pneumatic tyre. One or two of the earliest cars were fitted with wooden wheels and iron tyres, and they were an agony to ride in, for every irregularity in the road meant a jolt to the passenger. The first cars with solid rubber tyres were not much better, for faulty springs and bad roads made riding a pain instead of a pleasure.

It was real inspiration which caused J. B. Dunlop to select the only efficient shock-absorber to fit between a wheel and a bumpy road. That shock-absorber was a cushion of compressed air contained in a covering tough enough to prevent the stones in the road from cutting it and elastic enough to yield to the irregularities of the surface. This covering, which is one of the earth's wonders, is rubber, the solidified sap of a tree.

Until the beginning of this century, Brazil provided all the rubber the world needed. It was wild rubber, collected from self-planted trees in the tropical forests, and as the demand increased it brought a fortune to the collectors in Amazon valleys. Now the main source of supply has changed, in just over twenty years, to the cultivated plantations of Malaya and the East, and this remarkable change has been brought about by the foresight and sagacity of an English statesman, the late Lord Salisbury, who, as Secretary of State for India, wondered if rubber could be grown in India. The first expedition that went from England in 1873 to gather seeds and plants in Brazil obtained a few hundred seeds, but only twelve germinated and grew. Six of these young trees were planted in India and simply wilted away.

Costly as was this failure, the authorities at Kew Gardens were not beaten. They communicated with an English planter, who became known as Sir Henry Wickham, to ask him if he would collect a consignment of seeds. I need not dwell on the difficulties and dangers that confronted him, the possibilities of death from hostile Indians, from snake-bite or the attacks of venomous insects, nor the possible trouble with the Brazilian authorities if they understood how the export of seeds threatened their very existence. The great problem to Wickham was how to get the seeds safely and in good condition to England.

By the greatest luck a steamer from Liverpool had anchored at Para, which was ninety miles up the Amazon. With an audacity worthy of the pioneers of old, he went

to the captain, and chartered the steamer to go upstream through unknown waters to wait for the cargo of seeds which he was to collect. Eventually he stored 70,000 seeds aboard and got them safely to England. Every seed was planted, but only 2800 grew; 1900 of the young trees were conveyed to Ceylon and put in the Botanic Gardens there, and of the 50 of these which were sent to Singapore, 7 reached Perak and were planted in the Residency garden. Those few trees have created fabulous wealth; they have proved richer than gold mines. Now there are millions of acres of rubber trees in Malaya, all due to British foresight and capital.

This all happened, however, a year or two before Dunlop invented the pneumatic tyre, the rubber of which came from Brazil. While Dunlop was experimenting in Ireland, the horticulturists at Kew and in Ceylon and Malaya were fighting to solve the secrets of the tree which was to become so necessary to motor transport. They were all anticipating the needs of the future.

Born in the Ayrshire village of Dreghorn in Scotland, Dunlop took his diploma at the Edinburgh Veterinary College at the age of nineteen and went over to Ireland to practise. Although he loved horses, he did more than most men to banish them from the roads. The small solid rubber tyres on the great high ordinary bicycles in those years did not suffice to save the rider from road shocks, and the name "boneshakers" which those cycles received was fully merited. When the solid rubber tyres began to be superseded by the cushion tyre that was slightly bigger with a small air space in the centre, cyclists welcomed them as a vast improvement. This paved the way for the real pneumatic tyre, an inner tube filled with compressed air, protected by a stout outer cover, which Dunlop patented on July 23, 1888. The first Dunlop tyre was of modest dimensions, quite comparable with those in use on cycles now, but there were early variants of pneumatic tyres that were of enormous size, the forerunner of the modern balloon

tyres used on cars, only they were used on cycles, and rude little boys used to stand by the roadside and jeer and laugh at the riders, which is the general attitude the world over to anything strange and new.

It has often been stated that Dunlop got his idea for the tyre from a garden hose, and that the first tyres were in fact parts of a garden hose, but this is not true. Seeing his ten-year-old son, Johnny, ride across the yard one day, Dunlop noticed that the wheels of the boy's bicycle left deep tracks in the soft surface, and the idea came to him that larger tyres would not only sink less, but they would be much easier to drive. Thinking over the matter, while he very patiently cut a square of wood into a disc about the size of a wheel, he was inspired to make a hollow tyre filled with air. Getting some sheet-rubber, he solutioned it up and made an air tube, which he covered in turn with a strip of linen, and blew up by using a football pump and a piece of rubber tube from a baby's feeding-bottle. All this he did in an unused bedroom in his house.

When he had fitted his tyre, he took it down to the yard and bowled it across like a boy bowls a hoop; then he took an iron wheel and tested it in the same manner, to find that his tyre was a big improvement. Whereupon he ordered a straight length of rubber tube from a maker, cut it in two and joined the ends to make his inner tubes; then he made the outer covers of sheet-rubber as before, and fitted them to the wheels of his son's cycle. It did not take Dunlop very long to prove that his idea was a good one, and in his patent specification he is careful to state the method whereby the tyres are to be filled: "... the air or gas under pressure being introduced into the interior of the hollow tube through a small duct formed in the rim of the wheel and fitted with a non-return valve."

All the world must thank J. B. Dunlop for giving it that marvellous cushion of compressed air, the pneumatic tyre, to ride on; still, it is but justice to remember that another Scotsman, R. W. Thomson, who was born in

Stonehaven and had engineering experience with Robert Stephenson, actually patented a pneumatic tyre in 1845, taking out his complete patent in June 1846, in which year he fitted his pneumatic tyres to a brougham that drove about Hyde Park. This previous patent led to intense litigation, and cost those who acquired the Dunlop patent a fortune before it was settled. But Thomson died fifteen years before Dunlop obtained his patent, and, like many another inventor, Dunlop worked in ignorance that his patent had been anticipated. Thomson's patent merely makes the claim of British in this respect doubly secure. Dunlop little knew, when he created those first tyres with his own hands and tried them on his son's cycle, what a boon he was conferring on the countless millions who motor and cycle to-day.

Thinking of these two Scotsmen who both independently invented the pneumatic tyre reminds me that it was another Scotsman, a blacksmith named Macmillan, of Courthill, Dumfriesshire, who made the very first cycle to be propelled by mechanical means without the feet touching the ground. He fitted to the back wheel two levers which he worked by swinging the feet backwards and forwards, and on this iron-tyred cycle with its wooden wheels he rode forty miles in 1842, finishing up by knocking over a child and being haled off to Gorbals police court in Glasgow, where he was fined 5s. for his offence !

During the years that Britain was desperately battling to save Europe and the world from German domination, the American motor manufacturers had the markets of the earth at their command, and they were able to gain a position which, after the war, seemed practically unassailable. Nevertheless, there have arisen one or two Englishmen who have had the courage and the business acumen to improve on the methods of the Americans and create works and cars that are models for the world. A British " Baby " of 7 horse-power—designed by Sir Herbert Austin, K.B.E.—has done much

to revolutionize motoring, and other nations are satisfied to manufacture it under licence rather than endeavour to produce a competitor. Both France and Germany have been building the Austin Seven for some years, and it is pleasant to record the fact that these British light cars are now being built in America for the American market, and that orders have reached phenomenal figures. With more than a thousand victories to its credit on road and track, the Austin "Baby" upheld British prestige against the pace-makers of the world in the 1929 Ulster Tourist Trophy Race, for whereas forty out of the sixty competitors had to retire, all the Austin Sevens finished and one put up a splendid performance by running into third place with an average speed of 59·60 miles an hour.

Nor must I forget the Morris car, which has called into being a new town at Cowley, near Oxford. No greater romance can be imagined than that of Sir William Morris who, from building cycles, was in ten or fifteen years building thousands of cars in twelve months, and proving that Englishmen are still able to compete with their American cousins. Since 1919 the workpeople in the Morris factory at Cowley alone have increased from 180 to about 4750, and in that time Sir William Morris has built up an organization which in its engine works and foundry and other branches finds employment for from 17,000 to 18,000 people. It is a marvellous accomplishment. Henry Ford started the era of mass production, saving time by bringing the work automatically to the man instead of making him chase about after it; but Sir William Morris, Sir Herbert Austin, and others have become worthy exponents of the new methods.

It was a village bicycle shop in the United States that provided Orville and Wilbur Wright with a living while they perfected the first aeroplane which gave man the mastery of the air. Their genius made an age-old dream come true and brought them undying fame. But it was Thomas Sopwith who designed and built the first amphibian aeroplane that would alight on land or water;

the first real flying-boat, of which the mighty German Dornier Do X carrying a hundred and sixty-nine passengers is an offspring, was also English ; while the father of the giant aeroplane is Frederic Handley Page, whose first big machine, the 0400, I had the honour of flying in during its trial trip in March 1918, six months before the war came to an end.

Future generations, however, will probably remember F. Handley Page as the inventor of the slotted wing for aeroplanes, which is the greatest invention for ensuring the safety of an aeroplane in flight that has so far sprung from the mind of man. This brilliant idea is simplicity itself, although it was not so simple to work out and put into operation. While an aeroplane is flying, the air flows steadily over the leading edges of the wing and exerts a lifting pressure upon them. If the aeroplane is flown too slowly and loses its necessary flying speed, this steady air-flow breaks down and is replaced by an eddying mass of air which no longer exerts its full lifting effect on the wings.

The Handley Page safety-slots are fitted to the leading edge of the wing to prevent this breakdown in the air-flow, for when this breakdown occurs the machine falls out of control into a spin or nose-dive. These slots are formed at the leading edge of the wing between a little winglet which projects ahead of the main wing. In ordinary flight the little winglet nestles snugly over the main wing and cannot be distinguished from a part of the ordinary wing. Directly, however, the flying speed is reduced, and the angle of the plane to the air becomes great, the air suction on the forward edge causes the forward winglet to be pulled away from the main wing, leaving a gap or slot between the main wing and this little winglet. The air-rush through this slot prevents the formation of the eddying flow at the back, and allows the wing to go on lifting. In this way the lift on the wing is maintained, and the machine does not fall out of control. Some of our cleverest pilots have failed to make a machine crash with this attachment,

and the authorities of other nations have been so impressed by these uncanny performances that the safety device is being fitted to more and more foreign aeroplanes, so Handley Page may go down to history as the Briton who made flying safe.

With Zeppelin leading the world for years in airship design, Great Britain at the end of 1929 disclosed her native engineering ability by designing and launching the R 100 and the R 101. These experimental airships embody features which make them a distinct departure from the Zeppelin craft, and the heavy oil-engines of the R 101 banish that worst of all airship risks, fire from petrol. Even Dr. Eckener, the German expert, stated after his examination that the noses of the British airships are a big advance on anything yet built. If the ballonets of airships could be filled with helium instead of hydrogen, there would be no risk of fire, because helium is non-inflammable. But the United States alone has sufficient helium to fill one of its airships, and the authorities will not permit the gas to be exported. The cost of making the gas in Britain would be far too high to allow of it being used at present in our airships.

If we have lagged in airship design and construction, it must never be forgotten that a British-built army airship, the R 34, was the first to fly across the Atlantic from Britain to America and return safely to her base in England. That was a feat of the greatest historical importance, fully equalled by that other wonderful feat of Sir John Alcock and Sir A. Whitton Brown in making the first direct flight in a Vickers-Vimy biplane from Newfoundland to Ireland. The pilot and his observer had tea in Newfoundland on the other side of the Atlantic, and they took their breakfast in Ireland, after an exciting flight which lasted just over sixteen hours !

In the spring of 1929 a dozen men pushed a golden motor-car, that was British to the last screw, out on the hard-packed sand of the Miami beach in Florida. A man fitted himself into the seat, and soon he was rushing along faster than man had ever travelled on

land before. The least deviation would have meant death ; he was forced to steer towards a specially fixed mark at the end of the course, sighting his car just like a gun to make sure of keeping to the track. For one moment his car swerved and the sea was thrown up from the side wheels ; another time it struck a bump and leaped nearly a hundred yards before coming down again.

When at last the "Golden Arrow" ceased that dizzy flight, Henry Segrave, who risked his life for the honour of England, climbed out of his seat, to learn that he had beaten all the motor-car records that ever existed by travelling at a speed of just over 237 miles an hour. No knighthood was more bravely won than his on that day of thrills, for Death clung to his wheels all the time, and an American who sought to win the honour for the United States paid for his gallant attempt with his life. How Sir Henry Segrave met his death at Windermere is narrated in Chapter III.

Those British designers who set out to create water-cooled fixed engines in place of the air-cooled radial engines of the French saw the inherent dangers of a whole engine revolving in front of an aircraft, and consequently they boldly sought the aircraft engine of the future. Out of their early failures have developed the most wonderful aircraft engines the world has ever known, such as the Napier Lion, which in 1928 enabled four Southampton-Napier flying-boats, each fitted with twin engines, to fly from England to Australia, all round that island continent, and back to Singapore, a distance of 180,800 engine miles, without any mechanical trouble whatsoever. Such is the degree of perfection that British aircraft engines have attained in a few years.

Twice Napier engines have carried British seaplanes to victory in the race for the Schneider Trophy, but in the last race on September 7, 1929, it was a Rolls-Royce engine which carried the "Supermarine S 6" to victory in thirty-eight minutes at an average speed of 328 miles an hour for the 220-mile course. This engine, the most

SIR HENRY SEGRAVE TRAVELLING FASTER THAN ANY MAN HAS EVER TRAVELLED ON LAND SINCE THE WORLD BEGAN. HE IS JUST WINNING THE MOTOR-CAR SPEED RECORD OF THE WORLD FOR GREAT BRITAIN AT OVER 237 MILES AN HOUR. NOTE HOW THE SIDE WHEELS OF THE GOLDEN ARROW ARE OFF THE SAND, AND ALSO THE OBJECT SUSPENDED FROM THE CABLE OVERHEAD BY WHICH HE WAS ABLE TO SIGHT HIS CAR AND SO KEEP HIS COURSE

powerful in existence, was designed, put through severe tests, and raced between January and September—a very fine feat in itself. Probably that engine has never been flown in full throttle, or attained the highest speed of which it is capable.

Compact as it is, the engine is nevertheless a monster that is capable of developing 1900 horse-power, and on September 10, three days after the contest, Squadron Leader Orlebar attacked the world's air-speed record in the same machine. The distance of the course is fixed by the international authorities at three kilometres, or slightly more than one mile and four-fifths, which distance must be flown four times, twice in each direction, the average speed counting for the record. The first flight took place at the amazing speed of 368·8 miles an hour, the third flight in the same direction was at the speed of 365·5 miles an hour, and the average speed was 355·8 miles an hour. A later attempt raised the record to 357·7 miles an hour. So stupendous is this speed that if a howitzer shell had been fired at the moment the seaplane crossed the line, the aircraft would have arrived at the end of the course before the shell! And of course it travels so quickly that instead of the sound of the engine, a most terrifying and nerve-shattering roar, preceding the machine, the sound waves chase after it. In fact, it may be said to leave a trough of sound waves equivalent to the wash of a ship's propeller!

Mr. Mitchell, who designed the "Supermarine," stream-lined every part of it so scientifically, after experiments in a wind tunnel, that the air flowed smoothly away from her without creating a vortex in her wake as she hurtled through the atmosphere. The importance of stream-lining in attaining high speed cannot be over-stressed. A single small wire stretched between the floats of the machine might easily take five or seven miles an hour off her speed: the pressure of the air against the wire makes it act as a brake.

If the machine is a miracle, the man who flies it is

a living wonder, trained to a hair like an athlete to withstand terrific speeds whose varying pressures and forces operate on eye and hand and brain. His courage, too, is of the highest order, for a false touch means death. One of the Italian pilots lost his life by diving into Lake Garda in September 1929; another dived to his death in testing one of the Schneider machines after the race, preparatory to an attempt on the speed record; and Lieutenant S. M. Kinkead, in seeking to give Britain the record in 1928, dived at full speed into the Solent and was killed instantly.

Such supreme technicians as Captain Irving, who designed the "Golden Arrow," Sir Henry Royce, and Mr. Mitchell are the geniuses of the New Age. Thanks to them, and to the courage and skill of Sir H. R. D. Waghorn, Squadron Leader A. H. Orlebar, and the late Sir Henry Segrave, Great Britain has beaten the world on land and in the air.

The "Golden Arrow" cost £20,000 to build, and what the "Supermarine" cost is an official secret. Whatever they cost, they have proven more than worth while. They have glorified Britain, and shown that the isle which bred Drake and Shakespeare still holds its own against all comers.

CHAPTER V

MAGIC STEEL

AN elderly, grizzled man of less than medium height sat with an apron of sacking across his knees, hitting a stone with a hammer. As I watched the flakes falling away under the blows, the shed in which he worked seemed suddenly to change into an open cutting in the side of a hill, the modern clothes were transformed into the skin of an animal, while the grey hair changed into a tangled black mop. And, instead of a metal hammer, the skin-clad man held in his hand another stone with which he struck the flint before him with wonderful precision, and sent the flakes, with their keen edges, dropping to the ground.

I was in another world, thousands of years ago, before history began, in the very beginnings of Civilization, which this little man chipping flakes off a stone was starting to fashion in his crude way. This was certainly the Stone Age, and I was watching the Father of all Civilization starting on that gigantic task of remoulding the world nearer to his heart's desire—a task that goes on and on, and is as far from the end to-day as it was a million yesterdays.

Blinking my eyes again, I could scarcely believe them when in place of the skin-clad man I saw a happy-faced fellow with his shirt-sleeves turned up, the trousers on his legs protected by an apron of sacking across his knees, and the flakes of flint with edges keen as knives falling under his hammer. He was a flint-knapper of Brandon in the county of Suffolk, one of the last representatives of the first craftsman the world ever knew, one of the few men who get a living performing a task

which enabled men to live before they learned how to build houses or huts! For aught I know, he may be a direct descendant of those other men of the Stone Age who worked flints in his neighbourhood countless thousands of years ago, and his skill may have been passed on from numberless generations of forbears who existed in that dim past. It seems not only possible, but probable. I nodded cheerily to this Master of all the Crafts and passed on, wondering if his mind is ever stirred by some dim memories of long ago.

It seems incongruous to me that a man practising the art and craft of the Stone Age should be living in this Age of Steel. The secret of bronze, wrested from the earth perhaps by some happy combination of circumstances and metals, gave Man a new mastery, which he increased when he learned how to work iron. But the men who created steel, in all its manifold forms which we now know, have built a new world. Steel is the inner strength, the material core of our civilization.

Without steel some of the marvel bridges of the world, the Brooklyn Bridge in New York, the Tower Bridge over the Thames at London, that miracle over the Forth, would have been beyond man's accomplishment. Had they been attempted in cast-iron, the very weight of such heavy masses, owing to the brittleness of the metal, would have led to their collapse. But steel has the elasticity and strength which enable men to build lighter and stronger structures that are able to withstand all the stresses and strains of wind and weather and service.

Bridges of old were built of stone, of wood, of brick, or rope, and throwing an arched bridge of metal over a river was a prodigious progressive leap. As in so many other things, it was an Englishman who became Father of all the gigantic metal bridges in existence; it was this country which taught the nations that a new material was ready for spanning their rivers. That first metal bridge, which was made of cast-iron by the Colebrookdale Works and built across the Severn in 1780, is still serving

the public to this day at Ironbridge, which derives its name from what was then the unique material of which this arched bridge was built.

British engineers have since led the way in constructing the most marvellous bridges in many distant countries, as well as gigantic harbours and massive dams that are standing memorials to our engineering genius. The irrigation system constructed by British engineers in India, the mammoth dams across the Nile, those other gigantic undertakings in Britain and elsewhere, which have turned peaceful valleys into deep lakes, assure not only the teeming millions of the cities against drought, but prevent the very lands themselves from dying of thirst. British engineers have done more than those of all the other peoples put together to turn the desert places of the earth into lands of fruitfulness. The harvests are reaped year by year, but many of the men who made them possible have passed away unknown, their only reward being to see the life-giving waters clothe the wastes with verdure.

Something besides steel was necessary to construct these dazzling engineering works, something commonly known as Portland cement. The marriage of cement and steel provides the perfect union which seems to defy Time. Owing to the destructive power of the elements which had vanquished previous edifices, Smeaton faced a terrible anxiety in building the Eddystone Lighthouse, and in his search for something to bind his blocks of stone immovably in place he succeeded in making a mixture which set hard even in the sea, and which he described as bearing a resemblance to Portland stone. This was undoubtedly the initial step towards Portland cement.

Incidentally a sensation was caused many years later when the Harbour Master of Plymouth, testing the lighthouse with a plumb-line, found it was a quarter of an inch out of the perpendicular. He thought that the whole lighthouse was beginning to settle. Then a search was made among Smeaton's records, which allayed all fear and proved how wonderfully he had

built, for he wrote: "This day the Eddystone Lighthouse has, thank God, been completed. It is, I believe, perfect, except that it inclines a quarter of an inch from the perpendicular towards the north-east."

Although the lighthouse aroused a lot of attention, the importance of the cement holding it together was generally overlooked. Then a Leeds bricklayer, Joseph Aspdin, found in 1824 that mixing certain proportions of chalk with tenuous black mud or clay and drying and grinding the paste to powder provided a material which set as hard as rock. But none at the moment foresaw how important that mixture was to prove to mankind, and the greatest visionary could not anticipate that a century later the world would be using millions of tons of Portland cement a year, making thousands of miles of concrete roads for countless motor-cars to run on, erecting giant buildings and bridges and dams—all created out of that magic grey powder which was first conceived by an English brain.

Owing to the many advantages steel offers, it is being used more and more for the most diverse purposes. It has revolutionized building, for modern buildings are but steel skeletons bolted together and faced with brick and stone; inside such buildings you may find enamelled steel furniture. At this identical moment tiny steel rods are flashing in and out, writing this book on the typewriter. Steel locomotives thunder over steel railway tracks all over the world, steel ships sail every sea, steel trains run under the earth in steel tubes; without many special steels the British "Supermarine" seaplane could not have attained 357 miles an hour, nor could the "Golden Arrow" have flashed across the golden sands at 237 miles an hour. Motor-cars, machinery for driving the world, a variety of things so infinite that a mere list of them would fill several books, all these have been made possible by the metallurgist.

Not without reason is the name of Sheffield synonymous with steel, for while it is impossible to say where and when the first steel was made, the identity of the

first man to make crucible steel is well known. He was a Doncaster man named Benjamin Huntsman, whose love for his craft, that of a watch and clock maker, was so great that he simply could not rest content with the poor quality steel that he was forced to fashion for his work. When he removed to the fringe of Sheffield, which, owing to its situation, was already a steel centre, he wondered if he could make a better steel than that which came into his hands.

No one knows how many experiments he made, how many disappointments he had, how often he was obliged to draw on some inextinguishable well of courage to make another attempt. But years after he died, numerous faulty castings were dug up in various parts of the factory ground, indicating that Huntsman buried his failures, and that he did not succeed too easily. Then one day, taking a pot of fireclay, he smashed up some steel into small pieces, as he had often done before, and placed them in a crucible ; next he hammered a bottle to bits and spread the crushed glass over the steel, after which he put the cover on the crucible and pushed it into his furnace. There were but twenty pounds of the metal, and in a few hours, after it was melted and had set again, he was examining the first perfect cast steel man had ever handled. It was finer than any steel he had tried before—finer, in fact, than any that had ever been made. It was the first pot of cast steel, and although the Bessemer process and other processes were to follow in after years, crucible steel is still considered the finest quality of all.

Huntsman was delighted. He hugged his secret to himself and made some clock springs incomparably better than any others. He dreamed of wealth, and was surprised when the Sheffield cutlers refused to buy his steel because it was more difficult to work. Undismayed by this set-back, Huntsman sold it to French cutlers, whose knives of superior quality were soon being sold in Sheffield itself.

The Sheffield cutlers, failing to stop the export of

Huntsman's new steel to France, concluded that the next best thing was to buy it themselves. Which they did. They tried by all manner of means to solve how this magic steel was made. They questioned Huntsman, without result ; they attempted to suborn his workmen, but the latter were not to be bought. Then one winter night a tramp wandered into the factory, craving shelter from the icy blast and permission to warm his frozen body at the furnace. Stretching himself close to the fire, the poor fellow seemed to doze off while they made their secret steel—and when he left, Huntsman's secret left with him, for he proved to be a rival manufacturer in disguise.

A secret known to two is a secret no longer. Other men ferreted out the process, and the high quality of Sheffield steel won a name for the city which the steel-makers were not only able to maintain in after years, but even to increase. The bitter opposition of the cutlers at first nearly drove Huntsman from the city, but luckily for Sheffield he elected to remain. The works which he was obliged to build to cope with the demand for his crucible steel are still in existence at Attercliffe, making steel of the highest quality and exhibiting a clock spring and a pendulum fashioned from the first pot of crucible steel ever cast—one of the notable exhibits on which the fame of Sheffield itself was founded.

For the making of tools and springs and similar things where steel of the finest quality was not only desirable but essential, crucible steel ranks as a discovery of the first importance. Unfortunately, the expense of its manufacture made it impossible to think of building ships or railways of cast steel, for the cost would have been so large that no one could afford it. Therefore, as mentioned in the last chapter, the first steamships were of iron, as were the first rails for the railways.

All over the world men were experimenting with iron and steel, seeking something better, something cheaper, and improvements in the processes were gradu-

ally brought about. Two or three centuries ago these islands were densely wooded. The building of ships and the smelting of iron, the latter process being accomplished with charcoal, were largely responsible for the wholesale felling of trees. Miles of forests have vanished before the inroads of the iron-smelter, and the reason why Sheffield became a centre for steelmaking was primarily the immense tracts of trees to be found in the vicinity. To-day those forests have been transmogrified into forests of chimney-stacks, which poison the atmosphere with smoke and flame.

Steelmakers everywhere owe a debt to Dud Dudley, the son of Lord Dudley, who as a youth of twenty left Oxford in 1619 to manage his father's ironworks in Worcestershire. As wood and charcoal were "growing scant," he altered his furnaces "to attempt my new invention the making of Iron with Pit-cole." He was able to make iron and sell it at a profit of £12 a ton, and in 1621 his father was granted a patent for this new method of smelting iron with coke obtained from "Pit-cole." Like the Marquis of Worcester, who invented the first atmospheric engine on which Savery and Newcomen's pumping engine was based, this aristocratic iron-smelter, who presented the world with a new process of great value, proved that good ideas may germinate in the brains of all classes from the highest to the lowest.

Thus for a century fine steel was being made, although it was expensive. Other steel, less expensive, was imperfect. And a cheap steel of good quality was yet to be discovered. It is a sad commentary on humanity that war should so often prove a spur to inventiveness, yet the consolation remains that new things and processes called into being by war often prove useful when peace comes again. It was the Crimean War, starting in 1854, which led Sir Henry Bessemer to invent his process for making cheap cast steel.

Bessemer, who was born in Charlton, Hertfordshire, on January 19, 1814, and died in London on March 15, 1898, was the son of a Frenchman who was himself

London born, but after attaining a good position in Paris, the father was forced to flee during the French Revolution and settle down in England. Frequenting the foundry in Charlton where his father made type for printing, Bessemer grew to be familiar with the sight of molten metal, and his later work was no doubt influenced by these early scenes. Setting out at the age of eighteen to make a living in London, he invented a machine for stamping deeds which put a stop to the wholesale frauds then being carried on by using the same stamps over and over again—frauds which were costing the State at least £2000 a week.

Quite in the spirit of the old freebooters, the Government took his invention without giving him any reward —a despicable thing to do—and the knighthood which he received towards the end of his life was tardy recognition to the man who had saved the State from being defrauded out of huge sums of money. Bessemer's fertile brain, however, soon thought out a new invention for making bronze and gold powders for bronzing and gilding, and out of his secret process he made a fortune which enabled him to work out his other ideas. In all, Bessemer took out over a hundred patents, but the great idea which led to a revolution in steelmaking came to him during the Crimean War, when he sought to increase the range and the accuracy of a shell by rifling it so that it would spin while flying through the air.

Cast-iron cannon not being strong enough to do what he desired, he sought something stronger, and his search was successful solely owing to his keen powers of observation and a lucky chance. In 1856 he read before the British Association at Cheltenham a paper on "The Manufacture of Malleable Iron and Steel without Fuel." It created a sensation, for it announced his new method of making steel by blowing hot air through molten iron and thus burning out the impurities it contained. His hearers were quick to realize that Bessemer had entirely revolutionized the process of making steel, that under

his new method steel could be made at a reasonable cost, and its possibilities were therefore almost infinite.

How what appears to be a trifling thing may react on an intelligent brain and lead to a wonderful discovery is best related by Bessemer's own words : " Some pieces of pig-iron on one side of the furnace attracted my attention by remaining unmelted in the great heat of the furnace, and I turned on a little more air through the fire bridge with the intention of increasing the combustion. On again opening the furnace door, after an interval of half an hour, these two pieces of pig-iron still remained unfused. I then took an iron bar with the intention of pushing them into the bath, when I discovered that they were merely thin shells of decarburized iron, showing that atmospheric air alone was capable of wholly decarburizing grey pig-iron and converting it into malleable iron without puddling or any other manipulation. Thus another direction was given to my thoughts, and after due deliberation I became convinced that if air could be brought into contact with a sufficiently extensive surface of molten crude iron it would be rapidly converted into malleable iron."

Melting some pig-iron in a crucible with a special cover, he set an air blast blowing into it for half an hour, and although he could not see what was happening inside, he found a pot of steel when he had finished. Some people would have thought that the blast of air, passing through the molten metal, acted like the bellows act on the blacksmith's fire. There is no flame in the centre of a mass of molten metal, although there is terrific heat ; impurities submerged in the mass of the metal cannot burn because there is no oxygen to form the flame or incandescence to consume them. Bessemer, making his first converter, set the blast of air blowing right through the molten metal, and that air provided the oxygen necessary to destroy all the impurities. Smoke came rolling out of the top, then came a shower of white-hot sparks, followed by a great roaring flame that was terrifying in its intensity. And when the

flame died away and the molten metal was drawn off, Bessemer found steel just as he anticipated. By watching that flame the steelmakers learned to know when the steel was ready, for the first purple flames grow to an intense orange tint, which in turn changes to a vivid white incandescence that gradually turns blue as the last of the impurities are consumed.

Although Bessemer afterwards received well over £1,000,000 in royalties from steelmakers who used his process, he met with such opposition at first that he was obliged to set up his own steelworks in Sheffield. Not until he marketed the steel at £20 a ton cheaper than any competitor did manufacturers realize that they either had to make steel by the new method or go out of business, so they adopted the Bessemer process.

Bessemer found when he applied for a patent in the United States that his idea had been anticipated by William Kelly, who had been unable to compel recognition of the principle. But Bessemer was forceful enough to impose his new idea on the world, and it is to him alone that the credit is due.

Those early days of the Bessemer steel were fraught with difficulties owing to an excess of sulphur and phosphorus in the iron-ore making the steel brittle. Bessemer himself chose his ores very carefully, using mainly Swedish ore, which has a low percentage of phosphorus, and consequently his steel was good. But the experiences of other makers often led to them damning the new process as being useless.

It was in 1870 that Mr. G. Challoner, a lecturer at the Birkbeck Institute in London, remarked: "The man who eliminates phosphorus by means of the Bessemer converter will make his fortune."

Sitting in the class was a young man of twenty, Sidney Gilchrist Thomas, who, born at Canonbury on April 16, 1850, was acting as a magistrate's clerk at Marlborough Street Police Court during the day and gaining scientific knowledge by attending the evening lectures. That phrase burnt itself in on Thomas's mind;

it would not be dismissed; it appeared to mock him, challenge him to solve the problem. It seems ridiculous to think that he, a young clerk, without any knowledge or experience of metallurgy, could possibly overcome a difficulty which was defying the greatest metallurgists and steelmakers in the country.

Luckily for the world, Thomas, if this aspect of the case struck him, did not see anything impossible in his attempting to solve the problem. He began to read up the subject. Every book and paper that he could find bearing on it was carefully studied. He lived sparingly, saving every penny he could for future experiments. If he worked hard in the day, he worked harder still on his self-imposed task at night. He knew that lime absorbs phosphorus, but unfortunately if lime were mixed with the ore it would at once destroy the lining of the converter, which lining was siliceous, and lime attacks a silicate at once. He began to experiment in an attic at home, struggling to obtain enough heat to melt his metal, fighting with a dozen and one makeshifts and continually facing the danger of setting the house on fire. Night after night until the early hours he sweated in the heat, stripped to the waist, clad only in his trousers. And in the morning, often without sleep at all, he would go to the police court to do his work. It was not fame and fortune that he sought. His main urge was to do something that would help the whole human race, and in seeking his ideal there is no doubt that he ruined his health.

Concluding as a result of his studies and experiments that the phosphorus which caused all the trouble was actually burned out by the blast of air, and that it passed into the siliceous slag floating on the top of the molten metal, it seemed obvious to him that the phosphorus had a greater affinity for the metal than for the slag, and that the molten metal drew it back again as surely as a magnet attracts iron filings. If phosphorus were mixed with molten metal and lime, the natural chemical reaction drove it willy-nilly from the metal to

combine with the lime ; the phosphorus could not help itself. The key to the problem, as he saw it, was in the lining of the converter. If he could find a lining which would attract and hold the phosphorus, all the trouble would be at an end.

Six years after that lecture in the Birkbeck Institute, Thomas went to his cousin, Percy Carlyle Gilchrist, who was chemist at the Blaenavon Steel Works in South Wales, and begged his co-operation. Gilchrist, sceptical at first, consented to help Thomas by experimenting with some molten metal in a small crucible. Afterwards they made a miniature converter on the Bessemer principle, holding six pounds of metal, lined it with limestone bricks jointed with silicate of soda, melted the ore with which was mixed some lime, and found the way to solve the problem, for the phosphorus was held by the lime and run off with the slag.

Now another friend appeared in the manager of the Blaenavon Works, Mr. E. P. Martin, who gave them every help in his power. In 1878 the Iron and Steel Institute held its autumn meeting in Paris. On the table was a paper written by Thomas and Gilchrist "On the Elimination of Phosphorus in the Bessemer Converter." That epoch-making paper was ignored ; it was not read, and six months passed before the members of the institute were privileged to hear of the wonderful discovery which had been made by a magistrate's clerk !

Yet it was fortunate that Thomas went to Paris, for he met Mr. Windsor Richards, who was general manager of the Bolckow Vaughan steel and iron works at Middlesborough ; a special converter was built there for the young inventors, and Gilchrist at length arrived at the lining in use in the Bessemer process and the Siemens open-hearth process of steelmaking to-day. By burning dolomite until it was extremely hard, grinding it to powder and mixing it with tar, a basic lining was found which enabled lime to be used to combine with the phosphorus, a discovery now known as the THOMAS-GILCHRIST basic process. Bolckow Vaughan started

THE PRINCE OF [illegible] HADFIELD WO[illegible] OF SHEFFIELD, [illegible] FAMOUS METALLURGI[illegible] WHOSE INVENTIONS OF MANGANESE [illegible] UPWARDS OF £650,000,000, MAY BE SEEN WITH HIS HAT [illegible] LEADING [illegible] OF HIS [illegible]

making steel by this process in May 1879, at which time the combined output of the world's steel manufacturers was only 4,000,000 tons. In 1929 the world's output of steel made by the Thomas-Gilchrist process was 94,000,000 tons, out of a total steel output of 104,000,000. Nine-tenths of the iron-ore deposits of the world are phosphoric, and Thomas threw these gigantic deposits open to all steelmakers, who smelt a quarter of a million tons of this iron-ore every year.

Thomas killed himself by his hard work, but even when lung trouble supervened, and he should have been taking things easy in Algiers, whither he was sent by his doctors, he refused to give up. Day after day he experimented with a view to using the crushed slag as a fertilizer. His mother and sister watched his face grow thinner and more flushed. They could do nothing; science could do nothing to save him. They crossed the Mediterranean and arrived in Paris, where Thomas, who was only thirty-four years old, died on February 1, 1885. A practical idealist who sought to serve mankind, Thomas left his interests to his sister to be used as she thought fit for the " benefit of workers." His sister has spent her life carrying out his wishes.

While Thomas was fighting to perfect his process, a youth was busily engaged in making experiments in his father's steelworks in Sheffield. That youth is now known as Sir Robert Hadfield, Bt., D.Sc., F.R.S., one of the magicians of the Steel Age, who has done something much more wonderful than turning base metal into gold. Indeed, his discoveries have probably produced more wealth for the world than all the gold mines, for his invention of manganese steel alone is worth millions to its users every year.

So keen was young Robert Hadfield to penetrate the mysteries of metal that he begged to be allowed to enter the works and study at the same time instead of going to the university. His father was sensible enough to let him have his way, and by the time he was in his early twenties, at which age the average young man is thinking

of coming down from Cambridge or Oxford, he had created for posterity an entirely new metal—manganese steel. Nor was his discovery a lucky accident, for it was rather the result of an acute scientific mind seeking something new in a scientific manner.

The Terre Noire Company of France in 1878 produced a cheap combination of an alloy termed ferromanganese, in which 80 per cent. was manganese. Translating an abstruse and lengthy pamphlet by this firm, the young man learned that the Frenchmen had experimented with an alloy containing 2½ per cent. of manganese, and that the alloy was so brittle that it was quite useless.

It seemed reasonable to assume that additional manganese would simply make the resulting alloy more brittle. But Robert Hadfield was not prepared to accept assumptions as facts. He began to experiment with manganese, and in his book *Metallurgy* he quotes the following passage from his experimental records book for September 2, 1882: "I was led to make the following experiments with a view to the production of a very hard steel for tramway wheels and grinding wheels or discs to be used in the place of emery wheels. The experiments have led to some very curious, perhaps most momentous, results that may to some extent entirely revolutionize metallurgical opinions as regards alloys of iron and steel." Although only twenty-four years old when he wrote that, he proved a true prophet.

Finding that an alloy of silicon and manganese produced a metal exceedingly hard, but not very tough, Hadfield decided to experiment with a silicon alloy and a manganese alloy separately. Of two castings with different percentages of manganese, he found that one with 12·76 per cent. of manganese was a very tough material. And when a piece was broken, the crystals of which it was composed were so unusually long for a metal that they appeared to be almost like fibres of wood.

"That's no good!" thought the metallurgist, examining it: it looked much too soft for any known purpose.

His head foreman of the steel department of the Hecla Works in Sheffield was of the same opinion. Taking a file, which is made of the hardest steel known, he attempted to cut the new alloy. To his astonishment, the alloy stripped the ridges from the file almost as easily as a finger can remove the bloom from a grape.

Others tried to file the metal, and decided that the new alloy really was unusually hard. And when they tried to break it they found it very tough.

Generally, if a metal is hard, it becomes brittle; and the tough metal is usually soft. But here was an entirely new alloy which was both hard and tough. And tests indicated that these were not its only qualities, for it was a bad conductor of electricity as well as of heat. Later, Sir Robert made a poker of the new alloy, and found that even when it was left in the fire all day the handle did not grow too hot to hold. Truly the new alloy was more than remarkable, but the most remarkable quality of all was that it was non-magnetic. All iron will fly to a magnet, yet although there were eighty-eight parts of iron in this alloy, those twelve parts of manganese somehow prevented the magnet from exercising its natural attraction to the iron. It was almost as extraordinary as finding water running up a hill, and no scientist to-day knows why it is.

The queer thing about manganese steel is that it loves hard wear. It can be worn out more quickly by gentle treatment than by terrific wear. The more the wheels of tramcars and engines pound on it and grind it, the better it stands the wear; the action actually consolidates all the molecules of the outer layers of the metal, thus adding to their hardness and wearing capacity. For instance, it has been proved that when manganese steel crushers are used to crush a soft and friable ore, they wear out much more rapidly than those that are used to crush a very hard, refractory ore. It is one of the most extraordinary metals in the world, one that thrives on hard work, and the harder the work the longer it lasts.

Silicon steel, which the young metallurgist invented as a result of that first alloy of silicon and manganese, also was found to possess peculiar properties not known in any other metal, and to-day it is being largely used in electrical transformers and other electrical apparatus for which it is particularly suited.

At the time when John Brown of Sheffield began to make Bessemer steel rails, the directors of the railways were not easily persuaded to try them, although the firm was prepared to lay some trial rails free. The story is current that to overcome this opposition the firm sought the help of some of the platelayers on the railway which ran a siding into their works. Iron rails were surreptitiously withdrawn and steel rails substituted, and when the time had elapsed for the usual replacement of the iron rails, which would then have been worn out, and the steel rails were found to be unimpaired, the engineers were quick to see the advantages of the latter. As Bessemer himself claimed to have laid the first steel rails in 1862, it is not easy to arrive at the truth or apportion the credit.

Now, the cross-over points of railways and tramways are being constructed of manganese steel, generally known as " Era " manganese steel, which gives results, when compared with the old carbon steel, that are literally astounding. For instance, Hadfields built for the Sheffield Corporation Tramways a crossing of manganese steel which was laid in Fitzalan Square in September 1901. Previously it had been necessary to renew some parts every few weeks, and other parts every few months. This first manganese steel crossing was in use for six years until September 1907, during which time 5,225,000 tramcars passed over the junction, and although it was then good for several more years of wear it was necessary to replace it with a larger crossing to accommodate additional services. This new crossing lasted for twelve years, during which time 13,500,000 cars passed over it. These rails withstood the grinding action of 30,000 tons of tramcars every day, and they

THE STANDARD FRENCH HELMET, WEIGHING $23\frac{1}{4}$ OUNCES, WHICH WAS EASILY PERFORATED BY SHRAPNEL BULLETS THAT WERE TRAVELLING AT AS LOW A VELOCITY AS 350 FEET A SECOND

THE BRITISH HELMET MADE OF MANGANESE STEEL, WEIGHING $25\frac{1}{2}$ OUNCES, WHICH SHRAPNEL BULLETS TRAVELLING AT 750 FEET A SECOND COULD NOT PENETRATE, AND WHICH OFTEN RESISTED BULLETS TRAVELLING UP TO 900 FEET A SECOND

lasted *forty-eight* times as long as the old carbon steel crossings. Such is the miraculous wearing power of one of the many new metals which our foremost British metallurgist has given to the world.

It is worthy of note that the majority of the steel helmets for British troops during the war were made of manganese steel. They totalled upwards of six millions, and Sir Robert Hadfield was greatly disturbed one day when he saw in a newspaper a photograph of a Tommy boiling water for tea in his helmet. Manganese steel, of course, has to receive special treatment in its production, and heating it over a fire would destroy its protective qualities. Directly Sir Robert saw that photograph, he communicated with the authorities, pointing out the danger, and an order was at once issued to the troops forbidding the practice.

These helmets saved tens of thousands of British lives, but the young metallurgist in creating his alloy in 1882 little knew that it would be worn on the heads of his fellow-men. Although the French and Germans wore metal helmets, they were not so efficient as those of the British, and the French lost thousands of lives through head wounds caused by the missile penetrating the helmet. Seven days before the Armistice, the French authorities decided to adopt manganese steel helmets, and they saw Sir Robert Hadfield and asked how many helmets he thought they could obtain in a week. The Ministry of Munitions guaranteed 50,000 in four days, but they were never delivered, because the Armistice made then unnecessary.

It is estimated that by his inventions of manganese steel and silicon steel alone, both of which were duly patented by him, Sir Robert Hadfield has saved the world about £650,000,000. In the course of his lifetime, Sir Robert has carried out thousands of experiments, and as complete notes of each experiment were made for reference, it is extraordinary how he has found time to do all that he has accomplished. Not only has he made and tested nearly four thousand special steels, but

he has written and read before various scientific societies one hundred and eighty-nine papers, some in conjunction with other noted men. Indeed, he has come into contact with most of the famous scientists of the last and this century, as the unique list given in his book *Metallurgy* testifies.

The latest and by no means the least important discovery is that of stainless steel, which will ever be associated with the name of Thomas Firth & Sons of Sheffield. Like the Bessemer process, stainless steel is in reality a by-product of armament manufacture, and its invention was primarily due to the Director of the Royal Small Arms Factory at Enfield asking Firths to conduct a series of experiments with a view to discovering a metal for rifle barrels which would not be eroded or pitted by the gases due to firing.

Harry Brearley, then the head of Firths' Research Department, investigated several alloy steels, among them one with a high percentage of chromium, and various tests in 1913 indicated that this chromium steel possessed the unusual quality of being resistant to the corroding effects of various acids or re-agents which attack ordinary steel.

In a flash came the inspiration that this new metal would be ideal for table knives and all forms of cutlery. The alloy was found to take a high polish; it did not stain, and it therefore abolished the irksome operation of cleaning. Could any man confer a greater blessing on the homes throughout Christendom than give them knives that were always bright, clean, and readily sharpened? It spelt the death-knell of knife-boards and knife-cleaning machines, and the firms and mechanics making the latter have suffered in consequence, but the world in general is certainly better off.

Going to Firths as a boy of about fourteen, Harry Brearley has indeed carved out a fine career for himself. He sought knowledge, worked hard for it, and strove so well to master the science of metallurgy that in the end he rose to be the head of the research department of the firm.

Since then Dr. Hatfield, of the same firm, has developed a newer and even more effective alloy steel, which, in addition to chromium, includes a considerable content of nickel, and is so resistant to atmospheric influences, and of such pleasing appearance, that it is coming into use for shop-fronts of the most up-to-date type. The entrances to the Savoy Hotel and Theatre, and the Strand Palace Hotel, as well as some of the latest wonder-restaurants in London, are decorated with it. This new metal banishes the drudgery of cleaning and polishing, and its brightness makes it far more attractive than bronze, copper, or brass.

It is, however, in the chemical and other manufacturing industries that the unusual qualities of this metal are most appreciated, and if you were to visit the factories where British companies are extracting nitrogen from the air for the synthetic production of fertilizers, you would find mighty towers of this remarkable material, unaffected, even after years of use, by the drastic action of the chemicals. Owing to the corrosive influence of nitric acid, it has hitherto been essential to construct such towers of stoneware ; and as these deteriorated rapidly, the necessary repairs caused continual interruption and expense. This difficulty was overcome by the new metal, which, though at present somewhat costly, will no doubt become cheaper as manufacturing methods improve and the demand increases. The engineers who are raising the level of the gigantic dam at Assuan on the Nile are using such steel extensively, whilst more than 140 tons were employed in the repairs to the piers supporting the dome of St. Paul's Cathedral, a mighty stainless steel chain nearly 500 feet long, with links made of huge flat bars, having been fixed round the base of the dome itself to reinforce it.

Of all the manifold processes for the treatment of the different alloys, of the enormous heat obtained, of the quenching in oils and waters and reheating, of the cooling in air or slow annealing, it is impossible to give details. In armour-plate and armour-piercing shells

nickel and chromium play their part, while carbon, which is known in another form as diamonds, is the element mainly responsible for imparting hardness to steel and iron.

A special heat-resisting steel made by Sir Robert Hadfield had to be used for the terminals of the sparking-plugs that carried the Schneider Trophy winner to victory, for under the heat of 650 or 750 degrees centigrade generated during the flight ordinary steel would have been useless. These heat-resisting steels accomplish wonders, and the element mainly used for them is tungsten. One of the most fascinating sights in a machining shop is to see a red-hot cutting tool retaining its keen edge while shaving ribbons of metal from the shaft or gun-barrel which is being machined!

The Siemens-Martin open-hearth process of steel-making, which followed on Bessemer's discovery, was worked out in France in conjunction with Pierre Martin. As the regenerative furnace which made it possible was the invention of a German, Friedrich Siemens, whose brother, Sir William Siemens, came to this country to find fame and fortune and a title, I have refrained from dealing with it, not because I wish to deprive France and Germany of the credit for this important process, but because I seek to give Britain no more than the credit that is justly due to her.

All around us, wherever iron or steel is exposed to the air, oxygen is burning it away, eating it up. Rust destroys every year £500,000,000 of iron and steel. Think of the colossal benefit conferred by rustless steel when rainwater gutters, pipes, and other things can be made of it, and it becomes cheap enough to build bridges and ships with!

Cast steel, Bessemer steel, the basic steel of Thomas-Gilchrist, manganese steel, silicon steel, stainless and rustless steel, these are Briton's contribution to civilization. The Britons who brought these miracles to pass have given the nations of the earth the materials with which to build a new and better world.

CHAPTER VI

FOUR LANCASHIRE GENIUSES AND ONE FROM NOTTINGHAMSHIRE

SPINNING and weaving were two of the earliest crafts to exercise the fingers and minds of humanity. There are cotton and linen cloths in existence which were woven thousands of years ago by the Egyptians, while archæologists, exploring the sites of those ancient peoples who, for the sake of safety, were driven to erect their little dwellings on platforms mounted upon piles driven into the beds of lakes, have found among the debris fragments of cloth to prove that, for all their primitive ways, they yet knew how to spin and weave.

Exactly when or where the first human beings ceased to wear skins and began to weave a covering for themselves from the hair of animals and the fibres of plants will never be known, but in those dim ages, long before anyone could read or write, when men were groping for new sounds, which we now call words, to describe and explain things to each other, some savage genius conceived in his brain one of the most wonderful ideas that ever entered the head of man. That this idea sprang spontaneously to his mind is very doubtful. It is much more likely that watching a spider weave its web or a bird build its nest of grasses started someone a little more intelligent than his fellows striving to emulate them. He may have twisted a few stalks of grass in his fingers, set half a dozen reeds on the ground and woven other reeds through them. All is conjecture. The fact remains that in those far-off days he sought to do what had never been done before, to adapt to human needs

a craft in which mere insects and birds were already highly skilled.

As spinning and weaving were originally the tasks of women—hence the certain derivation of the word spinster, one who spins, and possibly of wife, one who weaves—a woman may, of course, have been the mother of the craft. A tiny child playing in a field of daisies and buttercups will learn to weave a chain of flowers without any teaching. The little fingers will fumble and play and twist the stalks, and lo! by some fairy magic the pretty blossoms have grown into a chain. Did a child unconsciously teach the first grown-up how to weave? Who knows?

A cotton fibre half an inch long, a hair from a camel, a sheep, a goat, think how many millions are needed to form a small piece of fabric. Here in a heap are countless cotton fibres and hairs, all lying in different directions, criss-crossing, twisting round each other, curling this way and that until it seems an impossibility that those innumerable individual hairs and fibres could ever be made to lie in the same direction. Yet man has learned to master them, to twist them into continuous threads; these tiny fibres and hairs, which have little length in themselves, are made to spiral round each other, like a bean or hop-plant spirals round a stick, and cling so tightly that they form long and strong threads. And by stretching hundreds of such threads from one beam of wood above to another below, and running another thread alternately in and out of them, all those millions of fibres and hairs are woven into a cloth. Truly the world is full of miracles.

Although the country in which spinning and weaving originated is unknown, these crafts certainly did not originate in Great Britain. Other nations were weaving and spinning when the inhabitants of Britain were still wearing the skins of animals. And it might be expected that as other nations were skilled in a craft of which Britain knew nothing, the greatest advances in weaving and spinning would spring from those peoples who had

practised the craft the longest. It is, therefore, all the more remarkable that the spinning and weaving industry of to-day owes its very existence to British genius ; in this island originated the inventions which turned a very ancient craft into a world-wide modern industry.

At the beginning of the seventeenth century the total population of Great Britain was less than the present population of Greater London. Railways did not exist. Roads were bad. With the exception of London, which had a lamp or two, the streets of cities and towns were not illuminated at all after dark. Candles made of tallow, evil-smelling things, and lamps burning whale-oil, equally offensive to the nostrils, were the sole means of lighting cottage and mansion. Petroleum and paraffin, gas and electricity, were yet to be discovered. A spinning-wheel and a frame for weaving were to be found in most of the country cottages, and the women spun and men wove the cottons and woollens and linens for their own homes, their children, and themselves. It was in the following century, when a few men began to send round to the cottages to collect cloth and sell it in the towns and cities, that the craft of spinning and weaving commenced to change into the very beginnings of an industry. Factories for spinning and weaving began to spring up. But the cottagers were content with the old methods and old ways, and they had no desire to change.

To John Kay, who was born at Walmersley, near Bury, on July 16, 1704, three months after his father died, Lancashire owes the impetus which set it on the road to prosperity. This son of a farmer in his youth made reeds for the weavers, but the primitive methods then practised struck him so forcibly that he puzzled his brains to see how they could be improved. The weaver used a wooden shuttle which, as it was slipped in and out of the upright threads, or warp, paid out another thread, the weft, compelling the weaver to use both hands in the task and making it necessary, each time the shuttle was passed from side to side, to beat

or push down the thread as tightly as possible against the previous thread, so that the cloth would be woven tightly without leaving gaps or holes. Sometimes two men were necessary to work the shuttle.

Studying the process, which was laborious and slow, Kay in 1733, when only twenty-nine years old, patented a new shuttle. His shuttle was a vast improvement on the old type. Managed easily with one hand, it automatically laid the thread of weft tightly against the previous thread, and a skilled weaver had no trouble in doubling his output. So quickly to and fro flew the shuttle, compared with those in use, that it became known as the fly-shuttle.

The inventor thought he had a fortune in his hand. The manufacturers knew he had placed a fortune in theirs, but they had no intention of paying for the blessing he had given them. They were nothing more nor less than thieves, intent on stealing Kay's invention, and when he began to take action for infringing his shuttle, they formed themselves into a " Shuttle Club " to fight him. Undismayed, Kay took them to court, and gained judgment against them in several actions, but instead of profiting thereby he found himself practically ruined by the legal costs.

As it is to-day, so it was yesterday. Human nature does not seem to change very much. The displacement of men by machinery is now a common topic of conversation. The same topic agitated the minds of the Weavers of Bury before the Machine Age dawned. They could see only ruin in the fly-shuttle ; it enabled one man to do the work of two, and therefore they thought that half of them would be robbed of their livelihoods.

" Wher's this blackguard who wants to starve us ? " they cried. " We'll show him ! " or dialect to this effect.

Taking up sticks and stones, the mob descended on his weaving-sheds and wrought havoc ; they rushed with fierce cries to his house, smashed the door and windows and battered sideboard and chairs and table—everything

in the house—to bits. They spared nothing. They would have torn the inventor himself to pieces could they have found him. But it is said that some friends of Kay, seeing them coming, induced him to hide in a bale of wool, and so hidden, surreptitiously got him away.

Had Lancashire encouraged him and treated him fairly, it might have had his power-loom and other improvements long before they came about. But Lancashire robbed him and stoned him and drove him to France. When he again visited England, his fly-shuttle was making fortunes for the thieves who stole it.

"I have a great many more inventions than I have given in," he wrote to the Society of Arts, "and the reason I have not put them forward is the bad treatment that I had from woollen and cotton factories in different parts of England twenty years ago. And then I applied to Parliament, but they would not assist me in my affairs, which obliged me to go abroad to get money to pay my debts and support my family." What a charge against Lancashire, against England!

Utterly discouraged, unable to obtain any reward for his invention, this Lancashire genius whom Lancashire robbed died in poverty in an attic in Paris. And Lancashire prospered on his brains and paid no heed. A century later, Parliament was approached to help the impoverished descendants of the man who had placed Lancashire on the road to prosperity; in death as in life the State ignored his claim. Yet Britain and the world continue to profit to this very day from his invention.

The greed of manufacturers and the ignorance of workers in those days were alike appalling. Some degree of civilization was supposed to exist, but the Lancashire men behaved like buccaneers and sought to crucify the very men who made Lancashire the cotton factory of the world. Those early days are a blot on the honour of Lancashire which can never be erased.

This was the mercenary spirit in the county when James Hargreaves first saw the light at Stanhill, near

Blackburn. There is considerable doubt as to the exact year when he was born ; although it is generally thought to be 1745, I incline to the belief that it must have been earlier, otherwise he could have been little more than a boy when he brought out his first invention about 1760.

That invention was revolutionary in a double sense. It not only revolved, but it started to revolutionize the cotton-spinning industry. Not that Hargreaves had any such intention at the time.

Working in a Blackburn cotton-mill, this untaught genius with the inventive brain was repairing the cards full of little teeth that the operatives used to comb and straighten the cotton fibres by hand, when inspiration came to him. Instead of men combing away to disentangle and straighten the cotton, he saw a roller with countless wire-points tearing its way through the tangle and forcing the fibres to lie straight, miraculously compelling them all to point in the same direction. Straightway the first carding-machine was made, and one of the biggest difficulties in cotton-spinning became easy. Apparently all he got for it was his usual wages and nothing more, and his employer, Robert Peel, reaped the full advantage of the invention.

Luckily for Lancashire, his inventive genius was to blossom once more and give to mankind the spinning-jenny. Until Hargreaves' jenny was invented, only one thread could be spun at a time, but the spinning-jenny enabled eight threads to be spun at once. It is generally believed that the spinning-jenny was the result of a happy mishap. Hargreaves was weaving in his home and had come to the end of his weft. Turning to his wife, who was spinning the thread for him, he knocked her spinning-wheel on the floor. It still turned, and as it spun round like a top, Hargreaves saw that if he used a wheel in that same position and set a number of spindles upright he might spin a number of threads at the same operation. If he could manage to do this, he thought of how much more cotton his wife could spin, how much more cloth he could weave, how much more

money he could earn, and how much easier life would become.

Full of such thoughts, he took some timber and began to fashion the spinning-jenny that was to change Lancashire. Not a soul knew except his wife, and when it was finished they tested the work of his hand and brain. The result delighted them both. He had invented something that would place them beyond want. They worked the spinning-jenny with a will, Hargreaves weaving and his wife spinning.

The output of the machine was the undoing of the inventor. The neighbours all knew how much cotton a woman could spin and a man weave in a day. How was it, then, that Hargreaves was producing so freely? Actually the jenny produced about eight times as much. Hargreaves heard the whispers, but did not worry about them. He set his hands fashioning another spinning-jenny or two for a particular crony here and there, to whom he sold copies of his invention.

The whispers from the neighbours grew; they hated to see Hargreaves starting to prosper. They breathed of secret machinery to other operatives, who carried on the tale. Soon Blackburn, with its 5000 inhabitants, and the neighbouring villages were seething with indignation. Hargreaves, "t'girt fule," was to ruin them all. Vowing vengeance, they swarmed down on his cottage and pulverized his spinning-jennies and everything else he possessed; then they wrecked the mill of Robert Peel to punish him for having harboured such a traitor to the working men of England. Knowing that his life was no longer safe in Blackburn, Hargreaves made all haste to Nottingham, while several mill-owners, including Robert Peel, shut down their mills and went elsewhere.

Hargreaves had no money, but he met a local carpenter, Thomas James, who not only had a modest sum saved, but who saw at once the advantages of the spinning-jenny. Together the two men, with their own hands and the help of a little casual labour, built a

modest factory that was little more than a shed ; it was built for utility, stripped of all adornment. Fashioning some spinning-jennies, they soon began to reap their reward.

In 1770, Hargreaves patented his spinning-jenny, but the Lancashire masters simply stole his idea and had their own jennies made, just as they had robbed Kay. Hargreaves, however, was determined to try to get justice. He lodged actions for infringement against so many thieving manufacturers that his own lawyer refused to fight for him. Even the State was intimidated by these powerful cotton interests, or so it seemed, for Hargreaves' patent was declared invalid in court because he had made and sold machines before he patented them, so these unscrupulous cotton manufacturers were able to continue to rob the inventor with impunity. Though robbed by the manufacturers, Hargreaves, when he died in Nottingham in 1778, had accumulated several thousand pounds for his wife and children.

In later years, when poverty struck down his children, an attempt was made to raise a fund for them, but those manufacturers who had made fortunes out of the spinning-jenny shut their purses just as they shut their hearts against the appeal. Sir Robert Peel, a descendant of the Robert Peel for whom Hargreaves made the revolving carding-machine, when he heard of the distress of the inventor's daughter, seventy years after her father's death, made her a present of £250—practically the only recognition the genius of Hargreaves ever received from his native Lancashire.

In view of the lack of business morality which existed in Lancashire at that time, it would be too much to expect that Samuel Crompton, who was born at Firwood, near Bolton, in December 1753, would receive any recompense for his invention of the spinning-mule, which spun a much finer quality thread than any other spinning machine then invented. Crompton, who lost his father when very young, lived with his mother in a few rooms

in an old mansion called Hall-i'-the-Wood, amid beautiful scenery. His mother was sensible enough to see that her boy went regularly to school, for she realized that education was something worth having.

The one thing Samuel disliked was having to spin the yarn with which his mother made quilting. Things so often went wrong while he was working a crude form of Hargreaves' spinning-jenny that his patience was sorely tried. The greatest source of trouble was that the threads were continually breaking as he spun them ; to join up the threads took time, and as he was blessed with an inventive turn of mind he began, young as he was, to seek a remedy.

Before that remedy was found, however, his creative faculties and artistic longings found outlet in making a fiddle, which he learned to play without any instruction in the solitudes of the old house. His fiddle was, indeed, a very great comfort to him, and often when depressed he played on his violin until his spirit grew brighter.

That he became no mean performer is indicated by the fact that he gained a place in the orchestra at Bolton theatre, and fiddled away for the munificent fee of 1s. 6d. a performance. Harbouring as much of this money as he could, he began to buy a few things to create the machine which had grown up in his mind. One week he would buy a saw, another a chisel, then some timber.

His days were fully occupied. Spinning from dawn to dusk, in the evening he hastened to Bolton to play in the orchestra, and when he came back to the derelict mansion at night, he got out his tools and toiled away at the machine which was to relieve him from those constant interruptions of breaking threads. Month after month for year after year he strove in secret to fashion his machine. Occasional passers-by, as they saw his light flickering on the window, began to spread rumours that the place was haunted. Other people, more inquisitive, managed to glean hints which seemed to indicate that young Crompton was making something

to assist him at the theatre, that he was going to become a conjurer, so he gained the nickname of the "Conjurer." He was actually conjuring out of his brain millions of pounds for Lancashire, but none for himself.

So unsettled were the times, so enraged at the mere mention of machinery were spinners and weavers, that Crompton was obliged to cut a hole in the ceiling in which he could hide his invention. More than once he was forced to dismantle the machine as quickly as possible and poke it out of sight. He met so many difficulties, but dared ask no one for advice or help, because he knew that the slightest hint of what he was about might lead to the destruction of his invention and the loss of his own life.

In such conditions, it was odd that he could find the courage to labour on. Yet some inner urge, some great belief in himself and his invention, kept him going. If only he could complete his machine, make it work perfectly, he felt sure that he would be able to earn money with it, consequently the machine assumed the paramount place in his life, and he devoted so much time to it that his earning capacity was curtailed in other directions.

When, after five years, his machine was made to work perfectly, he was without money, but he had in his hand something which would, he fondly hoped, make as much as he desired. Crompton called it a mule, because it was a cross between Hargreaves' spinning-jenny and Arkwright's invention, and as the spinning-mule it became known. It almost abolished those annoying breakages of thread, for it had a moving carriage which relieved the tension on the thread until it was ready to be wound on the spindle.

Crompton, with this means of livelihood, thought he might safely marry the girl of his choice, Mary Pimlott, a girl of some family, but no means except an expert skill at spinning, which was like to serve the young couple in good stead. Had Crompton possessed the money he would have patented his machine, and sought

to recoup himself by licensing it to manufacturers. But the manufacturers were so unscrupulous that they would probably have robbed him just the same, so it made no difference in the end.

Keeping the secret of his wonderful machine to himself, Crompton and his wife began to spin for their livelihoods. They spun such fine quality thread in such big quantities, and obtained such good prices for it, that news of it soon began to percolate through the district and beyond. Nobody knew the secret, but many suspected that it could only be the result of some marvellous new invention.

Strangers began to gather round the gloomy mansion, to peer through the windows. They were determined to wrest the secret from him. Continually he was being questioned when he went to dispose of his yarn, until his life became a misery. Rumour began to do its fell work, and Crompton in his soul realized that if they could not discover the origin of the new thread, they would probably kill him and smash his machine.

Arkwright himself sent men to spy out Crompton's secret, and a Bolton manufacturer, keen and avaricious, played upon Crompton's fears and pointed out that if he did not let the manufacturers have his machine, they would steal it in the end, and he might lose his life as well—which was true. This man got into touch with eighty-four other manufacturers, who each promised to subscribe one guinea or half a guinea if the inventor would give them his machine, which had forty-eight spindles.

The poor inventor wrote: "I was reduced to the cruel necessity either of destroying my machine altogether or giving it to the public. To destroy it I could not think of; to have to give up that for which I had laboured so long was cruel. I had no patent, nor the means of purchasing one. In preference to destroying it, I gave it to the public."

No sooner did Crompton hand over his model, than a number of the dishonest manufacturers went back

on their word, and robbed the inventor of the petty sums they had promised, as well as his machine! When Crompton approached them, they simply swore at him and abused him instead of opening their purses.

Taking a small farm in the neighbourhood, Crompton went on spinning and inventing. But the injustice he had suffered so embittered him that rather than give to the thieving manufacturers a new carding-machine he had invented, he took a hammer and smashed it to pieces. His every movement was spied upon: "I am hunted and watched with as much never-ceasing care as if I was the most notorious villain that ever disgraced human form," he wrote. Working on, a man without hope, he saw the power-loom come into use, heard that Cartwright, its inventor, had been granted £10,000 by the Government, and determined to try to get justice from the State for himself. He found that 4½ million spindles were being used on his mule, whereas there were not half a million in all used on the inventions of Hargreaves and Arkwright, and in the end the Government made him a grant of £5000. He hoped with this sum to make a fortune such as other men had made out of his mule, but his cotton-mill did not prosper. In 1824 some sympathizers in Bolton, who deplored the conduct of those manufacturers who had robbed him and treated him so foully, bought him an annuity of £63, which came to an end with his life on June 16, 1827.

Nor was Richard Arkwright himself less unfortunate in his early years, though fortune did smile on him in the end, and he gained a well-deserved knighthood before he died. This son of Lancashire, one of the founders of the modern cotton industry, was born in Preston on December 23, 1732. As there were already twelve other children, the poverty-stricken state of the family can be imagined. Those, however, who harbour the delusion that the number 13 is unlucky will note that he was the thirteenth child.

Absolutely uneducated, he was shaving men for a penny in a Bolton cellar before Crompton was born.

" Come to the subterraneous barber. He shaves for a penny," was the notice he displayed. To fight the local barbers he even reduced his fee to a halfpenny !

It was in 1761 that he set out on the road to make and repair wigs, after he had married a second time. It must be remembered that anyone of note wore a wig in those days, and that wig-makers were often in demand. Son of the cotton county, with people always discussing cotton and spinning and weaving wherever he went, he was naturally interested. The invention of the spinning-jenny in 1767, although it enabled perhaps twenty threads to be spun at the same operation, did not solve all the technical troubles that beset the weavers. The threads from the jenny were much too weak to be used for the warp as well as the weft. Had they been used for the warp, they would have been broken so often by the shuttle that weaving would have been impossible. So the warp was made of linen thread imported from Ireland.

Arkwright set his wits to making Lancashire self-supporting, and sought to produce a thread which was strong enough to use for the warp as well as the weft. His great idea was based on some rollers he had seen in an ironworks, and his spinning-frame in the end enabled raw cotton to be passed in at one end while the thread was spun and wound on to spindles at the other.

Ignoring everything else, Arkwright devoted all his time to his invention. The same year that Hargreaves brought out the spinning-jenny, Arkwright asked a clockmaker, named Kay, to make him a model of his first spinning-frame. The whole model was beyond Kay ; it needed a blacksmith and a tool-maker. Kay, however, started to make the gears and springs, and another man lent Arkwright a blacksmith and tool-maker for the heavier parts of the machine. Although the inventor was now without money, his model was completed.

To Preston he went with his model, and Kay set it up in the Grammar School House there, and showed it

to a man to whom he looked for further help. With the usual curiosity of provincial towns, the neighbours were soon seeking to know what was happening. They peeped in through the windows, quizzed anyone who went into the school-house, saw Arkwright and Kay doing they knew not what inside the room. The machine hummed and droned and clattered as it worked, and the neighbours thought the devil had come to town. Arkwright soon found himself in rags, with his fortune as far off as ever. An election took place at that time and he was asked to vote. "Not unless you give me something decent to vote in," he said—I will not attempt his broad speech—and he was bribed with a new suit to go to the polls and vote for his benefactor.

Reading the signs and portents in the air, and determined that the mill-hands should not smash his machine, which was patented in 1769, and the manufacturers get it for nothing, he set up a factory in Nottingham and began to show Lancashire how to manufacture cotton goods. Using horses to supply the power, he turned out excellent yarn and cloth; but horses were too expensive, and steam-power was not yet.

Shifting his scene of operations in 1771 to Cromford on the outskirts of Matlock, where his factory still existed twenty years ago, he began operations there, using a water-wheel to supply the power. Making cotton stockings and calico, he began to prosper.

The callous Lancashire manufacturers, determined to crush him, put forward an Act of 1736 that was passed to protect the woollen industry. Under this Act, every yard of fabric he exported could be taxed threepence, and he was prevented from making his materials at all unless he used a linen warp. He had invented his machine to overcome this very drawback, and now they were seeking to impose it on him! Could anything be more unfair, more farcical?

His fighting spirit roused, Arkwright pointed out the iniquity of the thing to the Government, how the old Act was a bar to prosperity, and in 1774 he had the

satisfaction of seeing the Act repealed and permission given to makers to manufacture materials "wholly made of the raw cotton wool." The new Act specified that the material should be stamped "British Manufactory," and that anyone using this stamp falsely, or knowingly selling material with a false stamp, was liable to be hanged!

A big improvement of his spinning-frame was patented by Arkwright in 1775, at which time he could not read or write. But he mastered both arts within a few years, and built and organized factories that poured money into his lap. And this inventive genius, who was also blessed with an unusual organizing ability, was a just and generous master.

The Lancashire manufacturers, still bent on ruining him, fought him over his patents so that they might avoid paying his fees. In July 1771, in his action against Colonel Mordaunt, his patent was set aside because the specification was said to be inaccurate. The inventor bided his time, and early in 1785 brought forward witnesses who had been able to make machines by following his specification, thus enforcing his patent once more. Then the whole force of the Lancashire cotton robbers was concentrated on Arkwright, and after a fierce trial in the autumn of 1775 these Lancashire manufacturers, who went to church and chapel on Sundays and spent the intervening time in cheating inventors out of their rights, gained a verdict, and the patent was once more set aside. But to-day we know with certainty that Arkwright was indeed the inventor of the machine on which the cotton industry of to-day is so largely founded. In spite of the intense opposition he met with, he made a large fortune and well deserved the knighthood he received before he died in 1792.

At his death, the basic spinning and weaving machinery was invented, but no one had succeeded in working the loom by power. That a clergyman should add this final touch which set all the wheels and cogs and shuttles and spools of the cotton industry whirring

under the force of steam is the unexpected which makes life so interesting. To suggest that a poet might help to found an industry seems too much to believe, yet to write poetry needs imagination, which is the great creative force of the inventor, and Edmund Cartwright was parson, poet, and inventor as well. Born at Marnham, in Nottinghamshire, in April 1743, this pupil of Wakefield Grammar School graduated at Oxford, and later became chaplain and tutor to two noblemen. The chance remark of a man that the new spinning-jenny and spinning-frame of Hargreaves and Arkwright would produce more yarn than men could weave, set his mind working on the problem of a mechanical machine for weaving.

Discouragement and difficulties did not deter him. A mechanical chess-player he had seen convinced him that a mechanical weaver was possible. Knowing nothing of weaving, he invented his first machine, which was crude but workable. Thereupon, he went for the first time to study weavers at their work, afterwards inventing an improved weaving machine which was patented in August 1787.

A man of rare mettle, the parson-poet inventor was obliged to set up a small factory in Doncaster in order to force his machine on the manufacturers. Satisfied by a short trial, he soon bought one of the steam-engines of James Watt to start his loom working by steam-power. The manufacturers were compelled to believe their own eyes. Seeing the machine at work and realizing its potentialities, one ordered four hundred from Cartwright. They were made, put in the factory—and in a night the whole place went up in flame and smoke. Men were mad against machinery; they would have murdered the men who made it, and that they deliberately set fire to the place there is little doubt, but it was never proved.

Cartwright was not to be intimidated by mob law. He produced a mechanical wool-combing machine that roused the fury of the workers to such an extent that 50,000 of them petitioned Parliament to forbid its use.

The Commons on this occasion were just and sensible, and refused to stand in the way of progress.

Brilliant though his inventions were, they brought Cartwright to poverty and led to his creditors, to whom he was indebted for over £25,000, taking over his factory at Doncaster. Still this Oxford scholar and poet could not curb his powers of invention; yet it was not until he saw Lancashire making fortunes from his machines that the philosopher rose in his wrath and denounced the injustice of it all. The canny master spinners and weavers who had made such fine profits out of him themselves induced Parliament to make him a grant of £10,000, leaving the taxpayers of the country to pay the money. On this Cartwright lived comfortably until he died at Hastings in October 1823. If the truth were known, he was probably much prouder of his poetry than of his inventions which were so fruitful to the British nation and the whole world.

Britain has cause to bless these five inventors who created the textile machinery on which the present industry is based. That one single county should produce in less than a century four such outstanding geniuses as Kay, Hargreaves, Crompton, and Arkwright is indeed remarkable, but any pride Lancashire itself may feel in them will always be tempered with shame at the savage way they were treated by masters and men alike.

Since the Machine Age dawned, Lancashire has flourished. Periods of depression there have been, and during the American Civil War, when supplies of cotton gave out, starvation stalked through mill-land, which nevertheless was anxious to see the slaves in the Cotton States freed.

Still more recently, at the close of the Great European War in 1918, Lancashire enjoyed the greatest boom it has ever known. The whole world, worn out by war, demanded cotton goods from the mills. The manufacturers simply could not cope with the orders; they were compelled to refuse business worth hundreds

of thousands of pounds. Customers clamoured for goods, were prepared to pay almost anything for them; they forced up the prices to an amazing degree.

This demand sent the whole of Lancashire dabbling in stocks and shares. Men made fortunes in an afternoon. Mill girls made thousands of pounds just by dealing in the shares of the mills they worked in. Mills changed hands time after time, and their value was doubled and quadrupled.

While the excitement was at its height, I was driven to write a warning, which was published on September 4, 1920, under the title *Are Lancashire's Mills Doomed?* In it I suggested that companies might in the future have to be reconstructed owing to over-capitalization, that shareholders would see their fortunes vanish, while operatives would be faced with a reduction in wages or the closing of the mills.

"Lancashire is lucky in possessing a climate which favours spinning," I wrote. "For this reason it has had what practically amounts to a monopoly of the cotton-spinning industry. But it can no longer count on this. The biggest markets for cotton goods are in the East, among the natives. If the Eastern markets are lost, Lancashire will be hard put to it to save itself.

"It may seem ridiculous to write about losing our Eastern markets at the present time. Nevertheless, things change rapidly in these days, and no harm can come of a little consideration of the matter. Anyway, this vital fact concerns all mill-land, and it is more menacing than most people realise.

"Cotton mills are gradually springing up all over India, and there are big enterprises afoot, directed by far-sighted and able men, who ultimately aim at supplying all India's needs from India's mills. Splendidly equipped mills are already working in Bombay and other cities, and many more are to come.

"Egypt, too, where more and more land is being put under the cultivation of cotton, is following closely in India's footsteps.

INDIAN EXTREMISTS BURNING BRITISH COTTON GOODS IN THE STREETS OF BOMBAY. SUCH ACTIONS NOT ONLY LEAD TO TROUBLE AND MISERY IN INDIA, BUT THEY SERVE TO DISCLOSE HOW UTTERLY IGNORANT ARE THE INDIAN PEOPLE OF THE BENEFITS THEY HAVE DERIVED FROM BRITISH RULE

"Native labour to run these mills is cheap. The present cost of labour in Lancashire is high. Then again, some of the Indian mills are relying on cheap water-power as opposed to Lancashire's dear coal-power. These are the reasons why a few people think that the knell of Lancashire's cotton trade has sounded, and that its mills are ultimately doomed. Now is the time for Lancashire to face the facts fairly and squarely, and make its plans for grappling with them. The menace exists, and Lancashire must bestir itself to escape."

Unfortunately for Lancashire, my words have come true, and the increasing exports of cotton goods from Japan, coupled in India with intensive Bolshevik propaganda against Britain, have made matters much worse. Lancashire has taught the nations how to spin and weave, our engineers have fashioned the wonderful machines for fitting up the factories which are bringing ruin on the cotton county, science to-day can create in the foreign factories an artificial humidity to rival the natural humidity of Lancashire. All over the county mills are closed down, many are operating at a loss, very few are meeting expenses, hardly any making a profit. The operatives themselves are working half time, and they have the chagrin of seeing in the local shops foreign-made cotton materials for sale at less than their bare cost to manufacture in England; further, conditions are so terrible financially that it is possible to purchase mills, fully equipped with the most up-to-date machinery, at one-tenth or one-twelfth of their cost price.

Lancashire all along has been the advocate of Free Trade. Its merchants have sought to send their goods, free of all import duties, to all the markets of the world. But import duties have grown all over the world until Lancashire to-day cannot send a yard of cloth to any country under the sun without paying an import duty upon it. And Lancashire operatives can walk into the drapers' shops in Manchester and buy cotton material cheaper than they can make it, cotton material which

is being imported into the cotton county duty free, to drive yet more operatives out of work. Wherever Lancashire looks she is faced by tariffs or import duties, modern factories with all the latest appliances to compete with her out-of-date factories, and native and European workpeople who are prepared to spin and weave for the barest sustenance.

The cotton operatives themselves, who are either out of work or on short time, complain of the present bad conditions, and yet many of them instead of trying to help themselves are positively foolish enough to spend part of the money they are drawing from Lancashire factories or from the local Labour Exchanges to provide wages for foreign cotton operatives. In one Burnley cotton mill a foolish operative regularly takes foreign cotton goods into the factory in which she works and sells them to the other operatives, one popular line being a German handkerchief for threepence. Such actions savour of lunacy, and it can be imagined how Mussolini would deal with them if they occurred in Italy.

In 1929 India imported cotton goods worth £6,000,000 from Japan. Lancashire's exports dropped by a similar sum. If this trade were deflected to Lancashire again, the mills would begin to hum and mill-land would lose its present depression. This country, which has welded a number of states warring against each other into the prosperous Indian Empire, has a fairer title to the Indian markets than any other country can rightfully claim.

Lancashire has led the world. It is useless to dwell on the past glories. Our cotton county must reorganize and rationalize and co-operate. Lancashire can only survive in the future if Britain adopts the fiscal measures which are used against her, and if British statesmen possess the ability to open for her the markets of India and the Empire in preference to giving the trade of those markets to foreign countries.

CHAPTER VII

TRANSMUTING TREES INTO SILK

SLOWLY, quietly, the roots of a mulberry tree push through the soil; their delicate tips coming into contact with resisting stones turn prudently aside and steal round them. The leaves, basking in the beneficent sun, act like little laboratories wherein chemical changes are wrought that enable new cells to form on the rootlets which stretch out and ever out, absorbing from the mould those elements which the sap carries upward to build up the trunk and branches and new leaves, dissolving in the sap of the tree the nitrogen which the rain brings down into the earth and those other chemical essentials of which the tree and every part of it is built. The roots, pushing relentlessly through the soil, concentrate on the task of supplying food to the branches and twigs and leaves; the branches and twigs and leaves, under the action of the sun and air on their surface, take from the atmosphere what they need to bring about those chemical changes that enable the root cells to grow and multiply.

On a leaf of the tree is a tiny larva, usually called a worm. It eats and eats until only the skeleton of the leaf remains, whereupon it moves off to the next succulent green morsel. That worm, a silkworm, absorbs from the leaves certain substances which the tree, in its own private laboratory, has prepared, and with these juices the silkworm not only increases the size of his own body, but he takes the sap of the tree, and storing it away in his two silk glands makes ready to perform a miracle. One day he starts to pump out through a tiny spinneret

near his head the liquid with which his body and ducts are gorged, and as the liquid emerges the worm moves round and round and round, so that the liquid flows continuously ; it is actually forced through the tiny orifice of the spinneret by a little pump, and as that liquid comes into contact with the air it magically hardens and is liquid no longer : it is a thread of pale yellow silk, and the silkworm goes on spinning and spinning until he has rolled himself up in a cosy ball or cocoon of silk for all the world like a Chinese mandarin. Sometimes the silk is so pale as to be almost white in colour, and that silken thread may be half a mile or more long.

For ages men have known how to unwind that delicate yellow filament and weave it into glorious garments ; they have formed silkworm farms for growing silk ; and some men have even taken the silk of a spider's web and spun that also into a lovely fabric.

That man could ever take other substances from the tree and, dispensing with the silkworm, do as the silkworm does and turn them into silk, seems too impossible to contemplate. Yet the impossible has come to pass. The greatest development of the textile industry in modern times is the discovery and manufacture of artificial silk. It is almost unbelievable that the shimmering stockings which add to the grace of the modern girl, or those beautiful dresses, were recently the branches and trunks of spruce trees growing in some foreign forest. That is no more than the truth.

In his book *Micrographia*, now in the Rylands Library in Manchester, Dr. Robert Hooke wrote in 1664 : " A pretty kind of artificial stuff I have seen, looking almost like parchment, horn, or isinglass, and perhaps some such thing it may be made of, which being transparent and of a glutinous nature, and easily mollified by keeping in water, as I found upon trial, had imbibed and did remain tinged with a great variety of vivid colours, and to the naked eye it looked very like the substance of silk. And I have often thought, that probably there might be a way found out to make an artificial glutinous

composition, much resembling, if not full as good, nay better, than that excrement, or whatever other substance it be, out of which the silkworm wire-draws his clew. If such a composition were found, it were certainly an easy matter to find very quick ways of drawing it out into small wires for use. I need not mention the use of such an invention, nor the benefits that is likely to accrue to the finder, they being sufficiently obvious. This hint therefore may, I hope, give some ingenious inquisitive person an occasion for making some trials, which if successful, I have my aim, and I suppose he will have no occasion to be displeased."

The dreams of yesterday are the accomplished facts of to-day. More than one man in the intervening two centuries was animated by the prospect of making some discovery such as Hooke suggested, but always the secret eluded him. In 1840, a Manchester silk manufacturer named Louis Schwabe attended a meeting of the British Association and placed before the members a machine he had invented for the manufacture of filaments that would take the place of silk. But, unfortunately, he could not find out how to make the substance that would give him the fibre he wanted, and the scientists of the British Association to whom he applied for help were equally baffled. Death claimed him before he could solve his problem, and another Manchester man, E. J. Hughes, who sought the solution that would produce a silken filament, was obliged to give up, beaten, in the end.

A Swiss in Lausanne in the middle of last century experimented with collodion, but he was not so lucky in his results as was Nobel. Collodion, which is derived from gun-cotton, has many uses, one being that of a liquid plaster for painting over cuts; it dries quickly, leaving a skin which promotes healing by preventing any germs from getting into the wound. The peculiar genius of Nobel enabled him to seize opportunities that other men would have missed, and two of his greatest discoveries were due to lucky accidents. Some nitro-

glycerine dripping into the earth from a leaky barrel induced him to take the soddened earth, dry it—and the result was dynamite. A cut finger, and the application of collodion to stop the bleeding, prompted him to mix some collodion with nitro-glycerine—and the world was the richer by a new blasting explosive, from which he received a huge fortune.

No one was more familiar with collodion than Sir Joseph W. Swan, and it remained for this famous British scientist to become the real founder of the artificial silk industry. Swan made several discoveries in connection with photography, but his two greatest discoveries—one of which was artificial silk—were of world-wide importance. Born in Sunderland in 1828, he started a factory at the age of twenty-seven in Newcastle to make collodion for photographic processes, and consequently for the major part of his life collodion was as common to him as it is rare to other people. That the same fluid which goes to form a deadly explosive may, when treated differently, be fashioned into a beautiful silk, or into film for cinema and camera, appears to be the height of imagination, yet it is but one of the multitude of miracles silently performed every day for our service.

For some time Swan had been seeking a substance which would provide him with filaments for quite another purpose, as the next chapter will disclose, and upon his settling at Bromley, in Kent, the whole force of his genius was concentrated on solving this particular and important problem. He had been in Kent but a few months when he patented his process for making artificial silk in the autumn of 1883. It was the first successful process ever invented, known to-day as the nitro-cellulose process, and although continental scientists later improved on this and other processes, to Swan belongs the honour of giving artificial silk to mankind. Just as the silkworm produces its filament of silk by pumping the liquid through a tiny orifice, so Swan produced his filaments by pumping them under pressure

through tiny holes. The liquid he used was nitro-cellulose, and before it could be used it was necessary to harden it, remove the nitrate, and leave only the cellulose. This Swan accomplished by passing the filaments through a chemical bath.

In 1885 he exhibited at the Inventions Exhibition the very first sample of artificial silk ever seen. There was no doubt in Swan's mind about the identity of his fabric : it was artificial silk, so he used the name of Artificial Silk for the first time to describe his filaments to the public. The scientist who had been dealing with collodion in large quantities for twenty-five years in the end turned it into artificial silk, for the glossy thread he made was derived from collodion, consequently the product which led to the invention of a new explosive also gave us the blessing of this beautiful new textile.

That, however, was but the beginning. The scientist again turned to those electrical problems which had engaged him for so long, and left Mr. C. H. Stearn, who was a bank clerk by profession and a scientist by choice, and Mr. C. F. Topham, who was a glass-blower by trade, to face and overcome the many difficulties that remained before the new textile industry could be set on its feet. Both men had helped Swan in his electrical discoveries and now they carried on this new work between them. All sorts of difficulties and setbacks were met with in dealing with the nitro-cellulose and seeking an easy method of production.

As mentioned earlier, the silkworm in spinning keeps turning within its cocoon. And I suppose there is hardly a boy or girl who has not at some time withdrawn a spoon from a tin of golden syrup and let the thread of golden syrup run in circles upon the bread and butter. I know that in the days of my youth I used to amuse myself by trying to write on my bread with the golden thread. Well, Topham eventually solved the production problem by letting the thick liquid cellulose drop into its chemical bath, which solidified it, and upon a circular tray revolving at the bottom. As the nitro-cellulose thread

fell on the tray, it was coiled round and round like a coil of rope. Sometimes the thread was a mile and a half or two miles long, and by coiling it in this way they found it much easier to handle and pass through the chemical bath, which robbed it of the nitrate, and then through the water to cleanse it.

Because Count Chardonnet improved on the process and opened a factory in France, it is often implied that he was the inventor of artificial silk, whereas his patent was not taken out until 1884, or a year after Sir Joseph Swan patented the first successful process for making this new fibre. Nevertheless, the artificial silk industry is considerably indebted to Count Chardonnet for the early work which he did.

In 1892 a totally new process was patented. This was the viscose process, which has proved to be the most important of all, for over two-thirds of the artificial silk made to-day is manufactured by this method, which was invented through the brilliant co-operation of two consulting chemists, Mr. C. F. Cross and Mr. E. J. Bevan, who practise their profession together in London.

At the top of New Court in Lincoln's Inn is a dull and dingy room which only the strong of heart, with a partiality for exploring, would ever reach, for the lungs and strength of an Alpine climber are required to overcome those endless flights of stairs. I paused before a door to get my breath; then, with a tap on the panel, I entered. It was not so much dust as the encrustations of bygone deposits that met my eye. A solid mahogany bench reminded me of Victorian times; a pair of balances, the metal dulled with age, with a sprinkling of leaden shot in each pan for weighing chemicals; cupboards and drawers with the paint worn off by handling; a few bottles and glass containers; some jars of crystals on the shelves; steam emerging from a square copper sterilizer at the end of another bench, and a sink near the window—these were the objects my glance roved over. It was a room to work in and not to rest in; no chair encumbered the floor. In this bare

little room, this laboratory stripped of everything but the essentials, the artificial silk industry really had its inception. Here, within a few yards of the Law Courts in London, while litigants were settling their quarrels, Mr. C. F. Cross was working out the reactions which eventually gave the world viscose silk.

"This was the first viscose silk ever spun," said Dr. C. J. J. Fox to me, and I held in my hand the first historic hank of silk, of a very faint biscuit shade, which led to developments that are a closed book to the average man. Those threads of silk have called into existence acres and acres of factories all over the earth; they have added to the charm of women and the wealth of men.

For ten years Cross and Bevan tried to interest manufacturers in their great discovery, for ten years they hawked their viscose silk all over the Continent and over Britain. They offered the manufacturers the opportunity to make millions, and the manufacturers were too blind to envisage the wealth hanging from those silken threads. That they ever exploited the invention at all is due solely to the tireless energy of Mr. Cross, who, once he had made his discovery, would not rest until the public were able to enjoy its advantages. He spent all his days trying to dispel the apathy of the textile experts. It was actually in France that a small syndicate was first formed to work the English viscose process under licence, and that small factory which started near Dieppe in 1900 with a staff of twenty-five people has since grown into a vast works.

In those days, Mr. Cross lived at Epsom, and used to journey to London each morning. Mr. Tetley, who lived in the same neighbourhood, travelled in the same train, and one day, while the two men were running up to Waterloo, Mr. Cross spoke of his viscose silk and invited Mr. Tetley to go along to the laboratory in Lincoln's Inn to examine it. Mr. Tetley, accepting the invitation, was acute enough to see the value of the new filament and brought it to the notice of his fellow-directors at Messrs. Courtaulds. They were at first by no means

impressed, and they failed to understand Mr. Tetley's enthusiasm. But after a series of discussions, lasting for some time, they decided to risk a little money.

"Here is £1000. See what you can do with that, and if the results look promising we'll go into the matter again," they said to Mr. Tetley.

That, so far as I can learn, is the true story of how Courtaulds first became interested in artificial silk.

A chemist working in his laboratory amid the legal lights of London, a chat with a neighbour in the train—Fate threw the right men together and a new industry was born in Britain.

If the problems of dealing with the nitro-cellulose filament as it came from the nozzle were great, they were as nothing compared with those that Mr. Stearn and Mr. Topham met when they tried to spin viscose filaments into a commercial thread. Experiment followed experiment, and all the time Mr. Stearn found his capital melting away. He kept on until he saw that he was heading straight for bankruptcy, and not till then did he decide to throw up the sponge.

Mr. Topham, however, refused to admit defeat; he would not hear of Mr. Stearn giving up. Such wonderful spirit did he show that Mr. Stearn himself was heartened and turned again to struggle with the difficulties. Their courage seemed to rout misfortune, and the God of Chance intervened on their behalf. Topham, who had drawn off some viscose for an experiment, was obliged to go away and leave it. When at length he came back, he saw that it had altered its character. It was a change which greatly simplified the problem of spinning, now known as the ageing process of viscose. Then the talented glass-blower went on to prove his genius by inventing the Topham spinning-box, one of the miracles of the artificial silk industry, and the amusing thing is that the inventor arrived at it by experimenting with an old blacking-tin and a bit of string! Spinning the tin on its string, he worked out the idea of his invention, which drives the filament to the side of the cylinder by

centrifugal force, and twists it and coils it tightly as the drum revolves, all in one operation—a very great advantage industrially.

Taking over the experimental spinning works at Kew, in 1904, Courtaulds have since grown into one of the biggest producers of viscose artificial silk in the world. But the initial struggles were simply heart-breaking. Sometimes a mixture produced good silk, at others the fibre was quite useless. Despite the most careful supervision, there was as much bad as good fibre produced, and spoiled silk worth thousands and thousands of pounds had to be destroyed. It was better to cast aside the faulty material than give manufacturers of textiles the impression that the yarn was unreliable. This was good policy, the only policy, and it paid, but it needed a large capital and big reserves to carry it through.

In recent years so many new factories have come into operation that the supplies of artificial silk have outrun the demand, consequently competition is waxing keener among the manufacturers, who are seeking to stimulate consumption by reducing prices. One of the biggest silk factories in existence, the Celanese factory at Spondon in Derbyshire, was built and used for making a protective dope for aeroplane wings during the war, and when the war came to an end, aeroplanes being no longer needed, Dr. Dreyfus and his brother succeeded in changing the whole output of the factory over to the manufacture of artificial silk by the acetate process.

Cotton and woollen stockings were the rule in pre-war days, and silk stockings were the exception to be found only among the wealthier classes. To-day the girl who cleans the doorstep, or the flower-girl, not only wears silk stockings, but she may even clothe herself in silk underwear instead of the cotton and woollen stuffs which pleased her mother. Had the pioneers of the silk industry been short-sighted enough to put their imperfect silk on the market, the verdict would have been that the new textile was no good and the development of the industry would have been greatly retarded

That man should be able to turn the trunks of spruce trees into silk clothing for men and women is one of the unrecognized miracles of our time, notwithstanding that the silk differs chemically from the silk spun by the silkworm. Man has learned to take from the tree the very stuff of which every root, branch, and leaf is built, the cellulose, and transform it by mechanical and chemical means into silk, just as the silkworm in the laboratory of its own body effects a similar transformation. Wonderful as it is, if man should feel inclined to grow boastful about it, the thought that a lowly worm performs the same magic without making any fuss, should help to restore his mental balance.

The spruce trees, after being cut down, are sawn into suitable lengths, the useless bark is stripped off, then the wood, chopped into small pieces, is heated for many hours in a chemical bath, which reduces it to a fibrous mixture. It is then bleached and turned into sheets of thick white paper. This initial preparation is the work of the papermill, and it is usually this product which the silk manufacturer takes and, by a most intricate chemical process combined with an equally intricate mechanical process, in which the most amazing machines are used —some parts of which are much more valuable than gold, for they are made of platinum—transforms into silk. If he does not obtain his cellulose from wood pulp, then he derives it from waste cotton, called linters—the shortest fibres from the cotton-seed pod, which are too short to spin.

Not the least of the troubles of the artificial silk manufacturer has been connected with the dyeing of the silk. But British dyemakers, after years of research, have produced a range of dyes specially suitable for this silk, dyes that equal anything produced by the Germans.

Before the war, the dye industry of Britain was dependent upon Germany for its colours. As the rest of the world was equally dependent, it cannot be said that Great Britain was worse than other countries. The

Germans made their name as the Master Dyers. They built up a most marvellous industry. They wrested the colours of the rainbow from coal-tar, and their position was such that they were generally accepted as the discoverers of aniline dyes.

As this assumption is utterly false, there can be no harm in dispelling it. The man who discovered the first aniline dye was a British scientist, Sir William Perkin, and upon his work the whole dye industry of to-day is founded. Perkin, who was born in London on March 12, 1838, was intended by his father to be an architect. Considering that Perkin senior was a builder, this is understandable. But young Perkin, getting over his boyish fancies, was enraptured with Chemistry, and the science master at the City of London School was so struck by the boy's keenness that he made him his helper. Realizing how unfair it was to stand in the way of such enthusiasm, the lecturer had a long interview with Perkin senior, with the result that W. H. Perkin, then a boy of fifteen, began to study under Hofmann at the Royal College of Chemistry.

Then Perkin was happy. He worked so hard that Hofmann, sensing something unusual about him, made him one of his assistants in the laboratory, which in turn made Perkin work harder than ever. He gloried in the tasks he had to do, and was so keen that he fitted a little laboratory at home where he could experiment in the evenings and during the week-ends.

Perkin was only eighteen when he made his discovery which added beauty to the world and enriched it beyond computation. He was experimenting during the Easter vacation of 1856 to see if he could extract a synthetic quinine from coal-tar, and, disappointed at his non-success, was about to wash away the dark deposit when he wondered if it were possible to extract a dye from coal-tar. The iridescent colours made by a drop of coal-tar when water touches it had no doubt struck him, as it has delighted the eyes of hundreds of thousands of observant people. Taking some aniline black, he

repeated the same experiment he had tried before—and the result was a beautiful purple dye.

Blessed with a supreme common sense, young Perkin ceased to go to the College and went to Pullars' Dye Works in Perth to learn all he could about the practical side of dyeing. And when he returned to London again he induced his father to put his money in a small factory at Greenford on the banks of the Grand Junction Canal. Although that factory was enlarged again and again, especially after Sir William discovered a method for extracting a synthetic madder dye from coal-tar, compared with modern factories it was a small place, and thousands of people must have passed it in the early years of this century without realizing that the wonderful German dye works, covering acres and acres of space and employing thousands of people, owe their inception to this drab little building with its broken windows standing by the side of the canal.

Perkin himself loved science so much that he retired from business after some years. At that time a few far-sighted business men might have made Britain the greatest dye-producing country in the world, instead of leaving the nation to perform the almost superhuman feat of building up a dye industry during the war, a feat worthy of a book in itself.

As a nation, the British have made the most brilliant discoveries, but we are rather prone to let other nations commercialize those discoveries, with a result that other nations have reaped a deal of the credit which is due to Great Britain. Fortunately this does not apply to artificial silk, the nitro-cellulose and viscose processes of which are outstanding British inventions. It is, therefore, pleasant to record that Britain stands well to the front of this new textile industry which her chemists and scientists have founded.

CHAPTER VIII

ELECTRICAL WONDERS

CEASELESSLY the huge dynamos spin at a tremendous speed in their steel cages, droning away like gigantic bumblebees in search of nectar. Before a black metal switchboard stands a man watching a dial; beneath, let into the metal, is a narrow strip of glass along which slides a beam of white light; if it slips too far to the left a red lamp flickers its angry warning, too far to the right sets a green lamp winking. Continually he is moving a handle ever so lightly, now this way, now that, to make the bottom indicators correspond with those above which tell him how much electricity is being used; his duty is to increase or decrease the supply of current to balance the demand and keep that beam of white light pulsating about the central line.

Now another man, glancing at the clock, operates some large switches. At his touch, thousands of lamps glow in the city streets. Darkness is banished. People can walk or drive in safety. No longer is it necessary to reach home before dark as it was in the early part of last century.

This is so wonderful, yet so commonplace, that no one ever gives it a thought. There is no searching for flint and steel or matches to light a tallow candle, a colza or paraffin-oil lamp, or gas. Just a touch on a switch, and lo! there is light.

Who first gave the world electric light was generous to humanity. And if the name of this benefactor were asked, all Americans and 99 per cent. of Britons would say "Edison!", without doubt the greatest inventor

who ever lived. On October 21, 1929, Edison re-enacted before the President of the United States, Madame Curie, who discovered radium, Henry Ford, the motor magnate, and other celebrities, the exact scene which took place when he made his first electric lamp glow fifty years previously.

To quote *The Times*: "For a few moments last night Mr. Thomas A. Edison recaptured the greatest triumph of his life when, standing in his old laboratory with Dr. Jehl, his assistant of fifty years ago, he recreated the first electric lamp."

Unfortunately *The Times* erred in giving Edison the credit for making the first electric lamp. That honour belongs to an Englishman, Sir Joseph Swan, and it was in seeking filaments for his first lamps that Sir Joseph made his other great discovery of artificial silk. Though, at first sight, there seems no possible connection between electric light and artificial silk, yet an electric lamp led directly to the invention of this beautiful new textile.

In 1860 Swan took a glass bulb, fitted it with carbon filaments, exhausted the air from it, applied an electric current, and had the satisfaction of seeing the carbon filaments turn red and glow. By December 19, 1878, after a vast amount of work, in which he was ably assisted by Mr. Stearn and Mr. Topham, whose researches and inventions helped to place the artificial silk industry on a firm commercial basis, Swan was able to show at an exhibition in Newcastle the very first vacuum lamps to be lighted by electricity. Electric light was then an accomplished fact.

Months later, Edison was experimenting with lamps in his laboratory, and it was not until the following October that he made his lamp glow, as the Englishman had done nineteen years earlier.

The differing characteristics of this country and the United States were clearly indicated during the Edison celebrations. That ceremony was organized on a national scale, speeches were broadcast, the whole of the

United States paid homage to the inventor, American newspapers were full of his praises and stories of the wonder he had accomplished; all the British newspapers, following the American lead, paid tributes to Edison for giving us the first electric light. Sad to relate, they were practically silent when the British Institute of Electrical Engineers celebrated, on December 20, 1928, the invention of Sir Joseph Swan's electric lamp.

As Mr. James Swinburne, a former President of the Institute, says: "Without detracting from the credit due to Edison for the great work he has done in other branches of electrical invention, we must admit that Sir Joseph Swan was the real inventor of the incandescent lamp, and that Edison added nothing to it at all."

If Swan had only taken out his patent a little sooner, Edison would not have been given the credit for it. As it was, Edison and Swan joined forces to manufacture the lamps in Britain under their joint names.

In my boyhood the lamplighter used to zig-zag across the streets from lamp-post to lamp-post, lighting the gas as dusk grew nigh. His long stick was surmounted by a brass cylinder, punctured by many tiny holes, in which was placed a lighted candle. Reaching the lamp-post, he would knock the gas tap until it turned, then he would hold the candle over the burner and the fish-tail flame would spring to life; often his candle would be blown out by the wind, and he would have to relight it; more than once I have seen him climbing a lamp-post to make some adjustment before lighting the gas. Early in the morning, while it was yet dark, his footfall would be heard in the silent streets as he tramped along in his hob-nailed boots—before rubber soles were invented—turning out the gas and saving the money of the ratepayers. The coming of the gas-mantle not only brightened the streets, but it lessened the work of the lamplighter, for he could dispense with the lighted candle and all the trouble it caused, and simply pull down the hook to turn on the gas, which was

lighted automatically by the by-pass, a tiny little gas jet that was left alight all the time.

Now the lamplighter with his long pole is just a memory. Progress has banished him. One man by a touch of the hand illuminates cities and puts out the lamps at dawn without so much as going into the street. Yet the crude gas-lamps were once reckoned a greater blessing than the powerful arc-lamps of our own time, for it was a much bigger jump from no street lighting—when link boys preceded wayfarers with a flaming torch—to gas, than it was from gas to electricity. And the man who first collected the gas from coal and used it as an illuminant was no mean benefactor to his people. In the year 1792, he was often observed walking in the pitch-black night from a neighbouring mine into the Cornish town of Redruth. In his hand was a lamp, the queerest lamp that was ever seen. It was composed of the bladder of an animal, with a clay-pipe, generally used for smoking tobacco, sticking out of it, and emerging from the bowl of the clay pipe was a flame. That was the very first form of portable gas-lamp, and the man carrying it was the Scottish genius, William Murdock, the assistant of James Watt.

Experiment taught him that coal gives off a gas that could be stored in suitable containers and lighted at will, and he startled and surprised the natives of Redruth by lighting his house with gas. On his return to Boulton and Watt in Birmingham, he lighted the famous Soho Works there with gas, and while the London gas companies were seeking to store gas for lighting purposes in balloons, he had already invented the metal gasometer such as is used to this day.

But for a wooden hat, Murdock may never have been associated with Boulton and Watt, although such genius as he possessed must have flowered some time. Applying to Boulton for a job, the Scotsman in his nervousness dropped his hat. Startled by the noise, Boulton remarked that it was a curious hat, and learned that it was a wooden hat which Murdock himself had turned on a

lathe and painted ! Boulton at once realized that this simple Scot who could make a wooden hat for himself might be an acquisition—and he was, at 15s. a week. Murdock himself, some years later, took the bull by the horns and suggested that his wages might be increased.

" What do you think ? " asked Boulton.

" Two guineas ! " replied Murdock. He had no inflated ideas about his own worth. He just possessed a wonderful mechanical genius and was happy when exercising it. Even so, he did not then get his increase of salary.

Yet he was very loyal to Watt and Boulton, and not even the offer of £1000 a year from the mine-owners of Cornwall to look after their engines could wean him from his old firm. As already stated, he returned to Birmingham, to light the Soho Works with gas, and win the Rumford Gold Medal for his brilliant discovery before he died on November 15, 1839.

In those early years of the nineteenth century, when Murdock was in his prime, the son of a Yorkshire blacksmith used to pore over the books in a bookseller's shop in South London. The boy, who was born in Newington Butts on September 22, 1791, loved books, especially scientific books. Every moment that he could spare, and many that he could not, found him revelling in all sorts of wonders that he could barely understand. But his extraordinary brain enabled him to puzzle things out and gave him an unusual grip of anything that he studied. For eight years he handled books, dusted them, sold them, packed them on the shelves, helped to bind them—and read those that appealed to him. Never was there a greater bookworm.

A visitor, dropping in to make a purchase, discovered him engrossed in a scientific work, learned a little of his fine character, and gave him tickets for a lecture by Humphry Davy at the Royal Institute, of which the customer was a member.

Young Michael Faraday went to the lecture. " I took notes, and afterwards wrote them out more fairly

in a quarto volume. My desire to escape from trade, which I thought vicious and selfish, and to enter the service of science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold step of writing to Sir Humphry Davy, expressing my wishes and a hope that, if an opportunity came his way, he would favour my views. At the same time I sent the notes I had taken of his lectures." So wrote Faraday afterwards.

Davy never regretted sending for the young man and engaging him as an assistant at 25s. a week. "My best discovery was—Michael Faraday!" he always said.

That sharp knock on the door, by that flunkey with a note, as Faraday was going to bed one night, was like the tap of a magician's wand, turning a bookseller into a world-famous scientist! Thus Faraday's greatest wish came true, and the door which led to utterly new and strange worlds was thrown open to him.

He helped Sir Humphry Davy, assisted at lectures, made experiments, imbibed knowledge all the time, went abroad with his great master to serve him in many personal ways. During that trip he saw Napoleon himself lounging in the corner of his coach, and he suffered the most contemptuous treatment from Lady Davy, even to the extent of being compelled to take his food with the servants. Occasionally he quarrelled with her, and forced her to be a little more considerate.

Deeply as such treatment cut him, he bore it all. Was it not for science? So much faith had Davy in Faraday's abilities that he arranged for his assistant to succeed him as lecturer at the Royal Society. When asked in later years to be its President, Faraday begged to be excused; the Royal Institute met with a similar reply to a similar request. A great man, humble in his achievements, he was content to wrestle for the secrets of the universe and place his knowledge at the disposal of humanity.

Over sixteen thousand experiments he made during his lifetime, keeping careful notes of each one: he

worked on gases, chemicals, glass; he made alloys of nickel steel and chromium steel, sending his mixtures to Sheffield by coach to be melted. As Sir Robert Hadfield, the foremost metallurgist of our time, remarks, had he continued these researches we might have had rustless steel a century earlier. He ranged everywhere, bringing his extraordinary brain to bear on a wide variety of subjects. But his greatest discovery of all led to the giant dynamos of the Electrical Age which is even now slowly dawning. It was Faraday who found out how an electric current can be generated in a magnetic field, and in ten days in 1831, he so thoroughly mastered and enunciated the fundamental laws on the subject that all the workers since have not been able to discover a single thing that he missed. His first simple machine was the forerunner of the modern dynamo.

Michael Faraday, by his many discoveries in electricity and magnetism, stands supreme as the Father of Electricity. His was the genius which supplied men with the knowledge whereby they have been able to construct those wonderful machines which store up electrical energy for all our manifold uses—for cooking, heating, lighting, and running factories, tramcars, trains, and battleships.

He might have made an enormous fortune in business circles if he had chosen, and Tyndall says he could easily have earned £5000 a year. But his sole aim was to further science and spread knowledge, and for some years his professional-business income was never more than £22, and for many years it was nothing at all. "I have always felt there is something degrading in offering rewards for intellectual pursuits," he once wrote.

Yet even a scientist cannot live on air alone, and his financial stringency was a source of such grave anxiety to his friends that their efforts led to the offer of a civil pension for him. When Faraday called to discuss the matter, Lord Melbourne insulted the gentle scientist by using the word humbug, with an adjective prefixed, in connection with it, and Faraday simply took up his

hat, walked out, and sent a letter refusing what his friends had been at such pains to obtain. They pleaded with him in vain to change his mind, and at last asked him on what terms he would accept the pension. He mentioned an apology, and Lord Melbourne, who by this time began to realize something of the nobility of Faraday's character, was happy to agree.

Thus Faraday was induced to accept a pension of £300 a year without any injury to his self-respect. A house facing Hampton Court Green was placed at his disposal, and as it was in a bad state of repair, and the scientist could not afford to do it up, Queen Victoria herself asked to be allowed to pay for the decorations. Here the scientist died on August 25, 1867.

During his association with Davy, the latter's notes, which were not too legible, were all copied out neatly by Faraday, who was allowed to keep the original notes. These he reverently bound up with his own hands into two volumes, which were a tribute to his skill as a book-binder, and eventually they were presented to the Royal Society, whose lecture-room had so often resounded with the praises of both men.

Faraday was a colossus among the pygmies in the scientific world, and his genius led him direct to conclusions which men of the following generations have since proved to be right. To Clerk Maxwell, the young mathematical genius who followed Faraday beyond the ken of other men, he wrote : " When a mathematician engaged in investigating physical actions and results has arrived at his own conclusions, may they not be expressed in common language as fully, clearly, and definitely as in mathematical formulæ ? " This was the man of the people pleading for something that the people could understand. I personally know by long experience how difficult it is to explain scientific subjects in popular language. It was here that Faraday shone. Perhaps one of his greatest gifts was the power of imparting to others the knowledge he had gained from his experiments.

It was many years, however, before Faraday's great discovery began to lead to tangible results, and only in our time has its general utility come to be realized. Those who explore totally new fields cannot expect instant recognition, and inventions of much value to humanity are often long neglected. Thus it was with the telegraph, with which so many men in the early days grappled and failed. Not so Sir Francis Ronalds, who may justly claim to be the first man to invent a workable and efficient system of signalling by means of an electric current.

In the garden of a Hammersmith house, in which William Morris afterwards lived, Ronalds erected a framework of wood on which he rigged a wire eight miles long. He also dug a trench over 500 feet long, and ran a wire through glass tubes, which in their turn were set in a wooden casing full of pitch, in order to test whether messages could be sent underground. His system was a notable accomplishment. By a clockwork arrangement, the letter or figure telegraphed appeared in a special space, and in 1816 his messages were flashing merrily along his eight miles of wire and also along his underground wire.

According to Ronalds, he put up his telegraph "amid scoffs and jeers and a few imputations of insanity." But he let the ignorant laugh. On the question of how to prevent evil-doers from cutting the line or interfering with it, he suggested: "If they still succeed in breaking communication, hang them if you catch them, damn them if you cannot, and mend it immediately in both cases!"

The Lords of the Admiralty must have hated inventors in those days, for when the telegraph was brought to their notice, they informed Ronalds that they were quite content with semaphores. They actually used to semaphore messages from point to point all the way to Portsmouth, yet they could not, or would not, see how the telegraph would save the nation's time and money. Probably they thought that, as Napoleon

was safely exiled, there was no need to expedite messages.

Ronalds, who was something of a philosopher, made no further attempt to force on the country something it did not want, so he dropped telegraphy, publishing his little book, *Descriptions of an Electric Telegraph*, in 1823. Apparently a Government has some sort of a conscience, but it took fifty-five years to stir, and in 1871, just two years before he died, the old gentleman was knighted for his early achievement. Who shall say that the English are not just to their great ones ?

Where Ronalds failed—in forcing people to use the telegraph—Wheatstone luckily succeeded, because a criminal was unfortunate enough to draw public attention to the advantages of the new invention. Wheatstone and his partner Cooke induced the Great Western Railway in 1843 to allow them to run, from Paddington to Slough, an experimental telegraph line, which was regarded more as a joke than anything else. One day the police, finding a poisoned woman, heard that a man dressed as a Quaker had been seen leaving her cottage. Rushing to Slough Station, they learned that the criminal had boarded the London train and was well away. There was absolutely no known means of catching him ; he had slipped through their fingers ; they were just too late, that was all.

" Why not telegraph ? " suggested a porter, who himself went to the little telegraph office and sent a description of the man to the police superintendent at Paddington Station. As the miscreant alighted from the train, Superintendent Collard took him gently by the arm and marched him off to the station. No man was ever more amazed than the criminal. He must have thought his arrest was brought about by black magic. Anyway, thanks to the telegraph, Tawell was caught and sent to the gallows for his crime. Thus a murder boomed the telegraphs into popularity in Britain.

As Wheatstone senior was a musical instrument manufacturer, it is obvious whence the son inherited his keen

interest in the science of sound. Born at Gloucester in 1802, Charles Wheatstone went to help his uncle in a London music shop, where he carried out a series of ingenious experiments, during which he connected instruments in attic or cellar with instruments in a room between, and by playing the instruments above or below, the sound was carried by the wire to the intermediate instrument which was apparently played without human agency at all !

Upon his appointment as Professor of Natural Philosophy at King's College, London, Wheatstone passed an electric current through a copper wire. As a boy he had seen Ronalds's telegraph sending messages in the garden, and he frankly admitted that Ronalds's invention was the father of his own.

It was 1837, however, before Wheatstone and Cooke patented their invention. The patent had barely been granted when Morse landed in England to patent his own invention of the electric telegraph, only to find that he had been forestalled by the Englishmen. Morse had worked out his invention in America while Wheatstone was working his out in England, but Ronalds invented the telegraph long years before either. Wheatstone, who made a fortune from his invention, died in 1875, two years after Ronalds, who gained nothing at all, except a little credit when he was dead !

Just as Great Britain led the world in land telegraphs, so she was first to lay a cable under the sea. That first cable was a single copper wire covered with a very thick layer of rubber, and it was laid across the Straits of Dover from England to France by the brothers Brett, who formed a company for this purpose in 1845. Messages were sent by the cable, which unfortunately was not strong enough to stand the strains it was called upon to endure, and by the end of the first day it broke. In September 1851 a new and better type of cable was laid, with four copper wires in the centre embedded in rubber, which was in turn protected by stout steel wires, so that in appearance the cable looked like a steel rope.

Within a couple of months the man in the street was able to send messages through it, and a similar type of cable is now to be found on all the ocean beds of the world.

The laying of the first Atlantic cable by an American and a British warship, which started steaming back to their own countries from the middle of the Atlantic, laying cable all the way, was a prodigious affair. The engineers were convinced that enormous power was necessary to convey messages such a long distance, but Professor Thomson, who will always be known to fame as Lord Kelvin, thought otherwise. He urged his view that vast power would destroy the cable, and that the way to make it a success was to transmit weak electrical impulses and catch them with very delicate recording instruments. His advice was waved aside—and the electricians destroyed their new cable in a week or two, whereupon they decided to allow Kelvin to have his way.

Sir James Barrie in his play *Peter Pan* uses a piece of mirror to reflect a light all about the theatre to represent the fairy Tinker Bell; the majority of schoolboys have amused themselves in the same way with a bit of looking-glass. Lord Kelvin similarly made use of a piece of mirror to fashion a most exquisite instrument for receiving electrical messages; the mirror, vibrating ever so slightly under the electrical impulses, magnified the vibrations by a reflected beam of light which enabled a man to read off a message as it came through. This invention, the mirror galvanometer, was but one of many that he made, and it enabled four times as many words to be sent in a minute as had previously been sent in an hour! His inventive faculty was extraordinary: he had the intelligence to see what was wanted, and the genius to invent the necessary instruments; he gave the world a new and more accurate compass, the most exquisite electrical instruments, dozens of other inventions that are in daily use. Apparently he could sit down and invent things as easily as the ordinary man sits down to eat his breakfast.

Born in Belfast, he matriculated at Glasgow University when he was only ten years old. His father, by sheer natural ability, and a minimum of schooling, had gained enough knowledge to become Professor of Mathematics there. Kelvin's genius showed itself when he was quite small. His father taught him in early years without sending him to school, and all through his student days he simply swept up prizes. Some of his papers were so far above the heads of his own teachers at Cambridge that they could hardly follow him. At twenty-two he was Professor of Natural Philosophy at Glasgow University, where his elder brother was Professor of Engineering, while his father was Professor of Mathematics—a remarkable record.

He towered above any other scientist of our time, with a genius for physics and mathematics as well as for invention. Lacking a proper laboratory, he was content to work out some of his inventions in a coal-shed at the University! The boy shovelling the coals smothered him and his helpers with dust; often they emerged like sweeps, but they were happy in creating new scientific instruments for the use of mankind.

For all his genius, Kelvin was the simplest of men, very, very humble about his own abilities. In 1896 his jubilee was celebrated as a professor at Glasgow University, and he said: "One word characterizes the most strenuous of the efforts for the advancement of science that I have made perseveringly for the last fifty-five years; that word is—failure. I know no more of electric and magnetic force, or of the relation between ether, electricity, and ponderable matter, or of chemical affinity, than I knew and tried to teach my class-students in my first session as professor."

While Faraday had the most delicate manipulative touch, Kelvin's impatience often made him so clumsy that he smashed the delicate instruments he had invented. All his life he was working, teaching, inventing for humanity. He died at Largs in Scotland on December 17, 1907, and although he gave the world many

things, he will be best remembered as the genius who helped to perfect the means of sending cablegrams for thousands of miles under the sea.

The wonders of cables and telegraphs are already giving place to greater wonders. Not only is man talking for thousands of miles over wires, but he is creating waves in the atmosphere and on them carrying the human voice to the pilot in an aeroplane scudding at 120 or more miles an hour, or to a ship in the middle of the ocean ; with those same waves he is carrying music and voices through brick walls and into the houses of millions of people, to their delight each night.

For the telephone and all the blessings it confers we owe thanks to Alexander Graham Bell, whom America claims as her very own, and one of the unique things in connection with it is that Elisha Gray and Alexander Bell both worked out the invention and applied for a patent on the same day in different cities of the United States—a coincidence that is extraordinary. Bell, whose father and grandfather had taken a lifelong interest in deaf-mutes, sought to invent an instrument whereby the deaf could read the spoken word in the oscillations of a reed. For long he experimented with the ear of a dead man, fixing a straw against the drum and letting the other end of the straw rest on a smoked glass plate. Speaking into the dead ear, he would watch the straw make little lines on the sooty glass as it jiggled up and down.

Valuable as such an invention would have been to the deaf, his attention was luckily diverted into striving to transmit speech itself over a wire. And the man who spoke into the severed ear of a dead man in order to discover how Nature achieved its miracle of registering sound waves, eventually worked out the telephone, after several years, and patented it on March 7, 1876.

A few months later he exhibited his instrument at the Philadelphia Exhibition, astounding the Emperor of Brazil who, listening into the receiver, exclaimed,

" My god, it speaks ! " Kelvin also saw that early telephone and brought one to England for experimental purposes. Before the British Association in Glasgow in August 1876, he said : " With my ear pressed against this, I heard it speak distinctly several sentences. . . . I need scarcely say I was astonished and delighted ! "

I have mentioned the telephone here, because it happens that Alexander Graham Bell was born in Edinburgh of Scottish parents in 1847. Educated in Edinburgh University, he later attended London University, his father being a lecturer at University College, and he did not leave this country until the age of twenty-three, when he went with his father to Canada, later receiving an appointment at Boston University. Born, bred, and educated in Britain, this Scot who migrated to America gave the world the telephone. Which country should be credited with this wonder, America or Scotland ?

Bell made a huge fortune out of this and other inventions, among them one for recording sounds on the phonograph. The phonograph, that first wonderful talking machine invented by Edison, with its revolving black cylinder, has long since been swept away by the gramophone. But the American sense of publicity values was never better exemplified than by those records, each of which, upon being played, exclaimed in loud, nasal tones that it was an " EDISON-BELL RECORD ! " The names of Edison and Bell have been dinned into the ears of mankind, but those people who buy gramophone records to-day would not tolerate the spoiling of their records by such a blatant form of advertising.

Bell's receiver for the telephone was quickly improved upon by Professor David E. Hughes, who invented the first form of microphone, as he called it. He thought his invention magnified the sounds, and he would often put a fly in a match-box and place it by the microphone to let people hear the fly walking about ! It seemed all right until someone heard the fly thumping about when it had actually flown out of the box ; then it

was learned that the loud noises were actually due to electrical vibrations in the telephone.

Hughes is another case of a man, born in London, who was educated in the United States, where he made a fortune out of his inventions—he left £400,000 to London hospitals and charities when he died in London in 1900. Before he was thirty he returned to his birthplace to continue his researches and experiments. He invented the microphone in London, and with it was able to detect wireless waves long before such a thing was declared to be possible. His first experiments in wireless telegraphy were witnessed by the most famous scientists of the day—Sir William Preece, the chief engineer of the Post Office, Sir William Crookes, Sir J. Dewar, and Professor Huxley. To their astonishment, Hughes sent signals through the very walls of the rooms, and the inventor has placed on record how he used to set his electrical transmitter working, and then walk along Great Portland Street holding the receiver in one hand and the microphone to his ear with the other. To quote his own words : " The sounds seemed slightly to increase for a distance of 60 yards ; then gradually diminish until, at 500 yards, I could no longer, with certainty, hear the transmitted signals."

Early in 1880 he amazed the President and some members of the Royal Society by sending wireless signals from various distances up to 500 yards, but Sir George Stokes and others absolutely refused to believe that the signals were made by electric waves, as the inventor maintained. Those scientists, whose minds had been trained to weigh and measure and test everything before they accepted it, found the theory of electric waves passing through the air and walls too utterly impossible to believe, and their incredulity robbed Britain of the honour of developing wireless telegraphy.

Depressed by the adverse criticism of his friends, Hughes was " so discouraged at being unable to convince them of the truth of these aerial electric waves that I actually refused to write a paper on the subject until

I was better prepared to demonstrate the existence of these waves. And I continued my experiments for some years, in hopes of arriving at a perfect scientific demonstration of aerial electric waves produced by a spark from the extra current in coils, or from frictional electricity, or from secondary coils."

In 1892, Sir William Crookes fortunately wrote in the *Fortnightly Review* on the subject of these experiments, mentioning his earlier experiences and forecasting the "bewildering possibility of telegraphy without wires, posts, cables, or any of our costly apparatus"— a prophecy which Marconi has since fulfilled. It is rather sad to think that, but for the discouragement of his scientific confrères, Hughes might have accomplished as much many years earlier, but, thanks to Crookes, we can at least pay honour to this genius who was a few years before his time. A pat on the back by Sir George Stokes, just the remark, "Of course they're electric waves." Such trifles change the world!

What, for instance, can be more commonplace than a burned-out electric bulb? It is far too general to excite interest, yet, but for a burned-out electric lamp the wonders of wireless telephony and broadcasting could not have been brought to pass. A man sitting in London may talk to his friend sitting in the *Mauretania* speeding along two thousand miles across the Atlantic; fast as an aeroplane flies, his voice can leap into the heavens and catch it instantly to give instructions to the pilot; as the famous violinist plays in the concert hall, his music is caught and carried five hundred miles far quicker than sound itself travels: the people sitting listening in a cottage in the Highlands hear it at exactly the same moment as those listening in the concert hall. They may, in fact, hear it sooner than those sitting in the back seats of the hall! Such incredible miracles, all due to a blackened lamp bulb! And the man to bring it about was Sir John Ambrose Fleming, D.Sc., F.R.S., one of the most brilliant electrical experts of our day.

The first scientist to be associated with Edison's

electric lamps in this country, Sir John arranged for the current to light them ; just as in later years he designed the first power installation to send at the touch of his hand that historic wireless signal which Marconi caught by his kite in Newfoundland, so he, more than most men, can claim to be intimately connected with the greatest of all electrical discoveries.

I shall always treasure the memory of him relating the romantic story of his great discovery to me in the laboratory of University College in Gower Street, the light shining on his silver hair and twinkling eyes, and illuminating the electrical apparatus in the very room where the germ of wireless telephony was born. Our conversation turned to those burned-out lamps.

" This discoloration of the glass was generally accepted as a matter of course," he said. " It seemed too trifling to notice. But in science it is the trifles that count. The little things of to-day may develop into the big things of to-morrow. I wondered why the glass bulb grew dark, and I started to investigate the matter. I discovered that in many burned-out lamps there was a line of glass that was not discoloured in any way. It was as though someone took a smoked glass, drew a finger quickly down it, and left a perfectly clean line behind. It was obvious to me that the filament acted as a screen to that particular line of clear glass, and that the discharge from the overheated point of the filament bombarded the remainder of the bulb with molecules of carbon and vaporized metal shot out in straight lines."

Experiments in 1882 and 1883 proved that he was right. Five years later the Edison and Swan Works made some very peculiar lamps for him, most strangely shaped, some with tubes springing out from them at right angles, others like the letter L ; and by experimenting with these he confirmed the fact that all the atoms discharged from the incandescent filament shot out in straight lines and were incapable of turning corners. His further researches not only indicated that these were

charges of negative electricity, now known as electrons, but that if he surrounded the negative filament with a metal cylinder and made the filament glow he was able to detect by his galvanometer that a current of negative electricity was flowing continuously from the incandescent filament into the metal cylinder or plate.

It is easy to understand why the current can flow only one way—that is, from the filament to the cylinder. The electrons are like porters all hurrying in one direction with a negative load of electricity. As there are no porters travelling in the opposite direction, it is impossible to get any current carried back again. The glowing filament is something like a battery of guns always firing shells at the same target, and the electrons are just as incapable of turning round and flying back to the filament from which they have been shot, as the shells are incapable of flying back to the muzzles of the guns from which they have been fired.

Sir John spent a good deal of time and money in conducting his researches, and in the end he found that he could obtain from a lighted lamp a small current of negative electricity. This was peculiar; it was even interesting in a mild way, but what was the good of it? Apparently it was no good at all, so Sir John packed those lamps with their metal plates inside them away in a cupboard and forgot about them. Then in 1899 he acted as electrical adviser to Marconi's Telegraph Company, and concentrated on solving the technical problems entailed in sending a message across the Atlantic, success being achieved on December 12, 1899.

In those days the coherer was used to detect wireless signals. It was formed of particles of metal which all leaped together when an electrical impulse touched them, and so formed a bridge over which the current could pass; but before it could be used again for another impulse, the filings had to be tapped so that they would separate and fall apart. Marconi improved on this by inventing the magnetic detector, but there was room for further improvement.

Wireless waves, of course, set up an alternating current in the aerial wires—that is, a current which swings backward and forward, and Sir John knew that if he could rectify this alternating current and change it into a direct current that could flow only one way and not swing back, he might use Kelvin's galvanometer to detect oscillations that were far too weak for any other known receivers to detect. Many were the things he tried, without success. Then one day his mind reverted to those previous experiments, which had seemed such a waste of time.

"Why not try the lamps?" he thought.

"Then and there I determined to see if they would serve my purpose," he said to me. "I went to the cabinet and brought out the same lamps that I had used in my previous investigations. My assistant helped me to construct an oscillatory circuit with two Leyden jars, a wired wooden frame, and an induction coil. We then made another circuit, in which we inserted one of the lamps and a galvanometer, afterward tuning it to the same frequency as the first circuit. It was about five o'clock in the evening when the apparatus was completed. I was, of course, most anxious to try the experiment without further loss of time. We set the two circuits some distance apart in the laboratory, and I started the oscillation in the primary circuit. To my delight I saw that the needle of the galvanometer indicated a steady direct current passing through, and found that we had in this peculiar kind of electric lamp a solution of the problem of rectifying high-frequency wireless currents. The missing link in wireless was found—and it was an electric lamp!"

On November 16, 1904, Sir John applied for his patent for the oscillation valve, as he termed it. That patent proved to be the master patent in wireless telephony and broadcasting, and the grid which Dr. Lee de Forest, the American, added in 1907 was only a valuable improvement of the Englishman's invention, so Sir John Ambrose Fleming gained for Britain the high

honour of inventing the valve which can pick electric waves out of the air and change them into voices or music for our delight. Thus a little thing like a burned-out lamp led up in the course of years, and after countless experiments by many scientists, to the modern miracle of wireless telephony.

It has also made it possible to telephone through wires overland for thousands of miles. By passing a weak current through a series of three electrode valves, it can be increased in power to almost any extent, each lamp making the current stronger. My experience of long-distance telephony is that the voices are much clearer than by the local calls. To talk to someone in England from a country a thousand or thousands of miles away, to hear the voice as clear as though the speaker were in the room, to be able to describe things that are of surpassing interest at the moment as though you had just met a friend in the street and were having a chat, these experiences have a vital interest. It needs only a wireless picture of the person to whom you are speaking and the illusion will be complete. And wireless pictures are well on the way, for a young Scotsman, John L. Baird, is slowly turning his theories into facts. Already he has harnessed the invisible rays to enable men to see in the dark, and can send by wireless waves a vision of a living, moving person. In the future years we may not only listen to a musical comedy or play in our own houses, but also see the actors and actresses playing their parts on the special screens or televisors that will become popular when television is perfected.

As Sir Edward Manville, the chairman of the Baird Television Companies, remarked in April 1930: "Not only were we the first to demonstrate television, but we were the first to transmit an image across the Atlantic, to transmit to a liner in mid-ocean, to demonstrate television in colour and in stereoscopic relief, television without the aid of artificial light, television without visible light, and we have now maintained our leadership

by the first regular public dual-broadcasting service of vision and speech."

In this connection the following extract from a story of mine published in a monthly magazine over twenty years ago is not without interest:

"The machine rose from her bed without a sound, two doors opened as her nose touched them, and she floated out into the pitiless glare. A little bell tinkled on the table in the cabin. He touched a knob beside the bell, and instantly the voice of a woman in distress came to him. . . . He touched another button, and upon the wall appeared the picture of a lovely girl trying to drag the figure of a grey-haired man to a couch. He looked eagerly at the man's face, and what he saw filled him with pity.

"'Too late!' he muttered.

"At the words, the girl in the picture dropped to her knees and began to weep, her sobs coming out of the nothingness with startling distinctness."

Of my early forecast of wireless telephony and television functioning in an aircraft while travelling through the air, Mr. Baird himself wrote: "Your short-story prophecy was quite remarkable." But my words are commonplace when compared with the career of the Scottish genius who turned that dream into reality. Born at Helensburgh, just over twenty miles from Glasgow, John Logie Baird, whose father was the minister of the parish church, first displayed his interest in electricity by rigging up his own telephone exchange with wires running from his window to those of four other schoolboys in the village. A gale started the trouble by bringing down the wires, which in turn lugged the local cabman from his seat by catching him round the neck, and the demands of that worthy for huge damages at the office of the National Telephone Company led to the junior telephone company going out of business rather suddenly; whereupon John Baird devoted his surplus energy to lighting his father's house by electricity. Developing this early liking for electrical science

by studying at the Royal Technical College and Glasgow University, he then served an apprenticeship as a motor-engineer, before becoming the Assistant Superintendent of the Clyde Valley Electrical Power Company.

His creative faculty was manifested after the war by the invention of a special hygienic sock, with which he launched out into business for himself. He was doing quite nicely when a breakdown in health banished him to the West Indies. Finding that the agencies by which he had hoped to live would not support him, and seeing that the island of Trinidad was flowing with fruit and sugar which, if not exactly milk and honey, were quite as sweet, he decided to add these two products together and make jam. Directly he started his project in the huts he had built, the forests wakened to life. The air grew black with insects. They must have thought that the gates of paradise had opened, for they came in their millions, humming their praise of the peri who was calling up such heavenly perfumes for their delectation, and dying happily in their droves as they dived to their fate. What proportion of that first boiling was fruit and what proportion insects was never determined. A mosquito avenged herself on Mr. Baird for the slaughter of those winged hosts by infecting him with malaria, eventually driving him to return to London, where he sold his Trinidad jam factory for £5.

In poor health, with little money, he turned to something else for a livelihood, and began to build up another business by importing honey. Within a year he had done sufficiently well to acquire an interest in a fertilizer business, which was beginning to make him a comfortable return when his health again gave way and obliged him to sell out.

After recuperating for some months at Buxton, he arrived in London to look round. His efforts in the past to sell socks and jam and honey and fertilizer displayed a catholic taste, and proved his willingness to explore all avenues to gain his end. This time he took an interest in soap, and was making good progress when

illness again supervened. That was the blackest moment of his life. The words of the doctor impressed themselves on his brain: they banished him from London for ever, so grave was his condition. Quiet by nature, not given to making friends easily, shy at expressing his innermost thoughts and fears, John Baird cleared up his affairs and determined to fight hard to get well once more.

He went to Hastings, where the pure air, combined with absolute rest, enabled him gradually to recover. And it was while lying helpless in bed there that his mind began to dwell on television, and he started to study with renewed interest the peculiar properties which enable selenium to respond to every variation of light.

Taking a small room above a shop in Queen's Arcade directly he was better, he built the very first television apparatus ever known. A tea-chest, a tin biscuit-box, a toy electric-motor, price 5s. 6d., and a glass bull's-eye costing 10d.—such were some of its components. You may see that original machine at South Kensington Museum, and the marvel is that with this machine, built of make-shift materials, John Baird, after experimenting for months, saw, in 1923, the first thing ever televised in this world—a Maltese cross.

Selling a third share in his invention to Mr. Wilfred Day for £200, Mr. Baird set up a small laboratory under the eaves of a building in Frith Street, Soho, and spent all his days and most of his nights in struggling to improve his apparatus. An unexpected visit from Mr. Gordon Selfridge, and the offer of a fee of £50, induced Mr. Baird to make the first public demonstration of television in Selfridge's Stores in Oxford Street in April 1925. Despite the imperfections of those crude black-and-white images, the scientific world became really interested; but to many, the difficulties looming ahead seemed so insurmountable that they failed to see in television anything more than a freak toy.

People made the usual inane remarks of how wonderful and passed on, leaving the inventor fighting

JOHN AM[illegible] WHOSE INVENTION OF THE THERMIONIC VALVE LED TO [illegible]ADCASTING, SITTING IN FRONT OF THE TELEVISI[illegible] WHEN THE B.B.C. INAUGURATED TELEVISION TRANSM[illegible]SION ON SEPTEMBER 30, 1929. TO THE RIGHT IS [illegible] BAIRD WHO ACHIEVED THE MIRACLE OF TELEVISION. THESE TWO BRITI[illegible] SCIENTISTS ARE AMONG THE FOREMOST PIONEERS OF THE NEW AGE

against financial difficulties which grew worse every day. Lacking the money at last to buy meals, Baird walked London seeking encouragement and financial assistance until his boots were in holes and his feet showing through them. Genius was starving in the richest city on earth and no one took the slightest notice. It reminds me of another genius, Francis Thompson, who wrote that inspired poem, " The Hound of Heaven," and was glad to sleep on the seats of the Thames Embankment.

Baird turned here and there, only to meet a blank wall of indifference, which was worse than real opposition, although he was to meet real opposition later in quarters where encouragement might have been expected. He was the pioneer of a new era, juggling with mysteries which the people around him could not understand. The landlord was dunning him for rent; Baird himself was going hungry. He knew not what to do, and eventually, in his desperation to save his tiny laboratory and himself, he was obliged to sell his first apparatus, just as Friese-Greene, who gave the world Cinematography, saw his own priceless apparatus knocked down at auction for 30s. before he was sent to gaol for debt.

To Baird, who had been gamely battling against defeat for so long, it seemed to be the end. He parted with the apparatus which had performed the greatest miracle of any age, and in his profound depression wrote to his folk in Scotland, a thing he could not bring himself to do before. That letter brought forth the funds that were so essential to the enterprise, and by October 1925 he saw for the first time, in all its detail, the image of his experimental doll on the screen.

Dashing out into Frith Street, Baird bumped into an office boy, William Taynton, and coaxed him to go into the laboratory to be televised. The boy did not know what was going to happen. He probably thought that the wild-eyed young scientist was going to electrocute him, despite the assurance that there was no danger.

Seating the boy before the apparatus, Baird went into the next room, switched on the neon lamp, and started the scanning disc whirring. He looked at the screen in which he had just seen the perfect image of the doll. There was nothing. The screen was blank.

Very disappointed, and unable to understand it, Baird went back to the other room. Instantly he saw the reason for the failure. The boy, scared by the whole business, had simply retreated out of the line of vision. A few more explanations and a bribe of half a crown encouraged the boy to sit still. This time a few distorted images such as those seen in distorting mirrors flowed down the screen as Baird switched on, and a slight adjustment brought forth the perfect image of William Taynton. Television was no longer a half-proved theory, but a fully-proved fact.

To that first fact, Baird has since added others even more remarkable. He has learned to scan people with the invisible rays of light so that while sitting in complete darkness their features may be seen in the televisor as clearly as though they were sitting beneath a tropic sun ; he has obtained his images in broad daylight ; and perhaps the most wonderful invention of all has enabled him not only to store up the sounds of a voice upon a gramophone disc, but also to lock up in concentric lines upon the same disc the actual portrait of the speaker. Centuries hence such records may be reconverted on a screen into the living image of the person, whose voice will speak as in life.

My resolve to deal with this new science led me to seek out the worker of miracles, and I am truly grateful to Mr. Baird for the most interesting demonstration of television which he gave to me. The studio is a room of silence, with walls draped in heavy velvet to deaden all sound and a thickly carpeted floor which enables one to move as noiselessly as a cat. Before a panel in the far wall stands an adjustable chair, to the left is a portable microphone, and in the black panel itself is a small aperture through which shines the beam of the neon

lamp. At the top of the panel, set at an angle of forty-five degrees, are the four improved photo-electric cells, whose reactions to light are so very much stronger than those of selenium that Mr. Baird has discarded the latter entirely. Under the ebb and flow of the reflected light these cells convey to a distance those electrical impulses which are reconverted into the image seen on the screen. The cells are about an inch and a half long, tightly wound with black, silk-covered wire, and in appearance resemble those small coils which vibrate the striker of an electric bell.

"The scanning disc operates through there," said Mr. Baird, pointing to the aperture, and the fugitive beam of light was soon chasing in circles round my face to televise me for the secret scrutiny of the expert in the next room. Then the inventor took me into the inner sanctum, and for a moment or two I watched the elements of a face assembling and dissembling on the screen until Mr. Baird, with the turn of a switch, brought the face of the expert in the next room clearly into the centre of the panel. The face was illuminated as by the summer sun, and vertical black lines made an endless procession across it. So I watched the face of the expert and heard him explaining things to me, although he was completely hidden from my eyes by solid walls.

On July 1, 1930, I witnessed the first demonstration of a new type of screen which Mr. Baird patented in 1923. Stepping into a lift, I was carried up to the roof of the building while a gorgeous sunset trailed flaming banners of clouds across the sky. Directly the purple gloom closed down on the vista of chimney-pots and roofs, I watched the life-sized images of people appear upon the screen and listened to them talking and singing in that invisible studio many floors below me.

That screen resembled a huge honeycomb, made up of over two thousand tiny electric lamps, each set in a neat compartment ; and as the beam of light traversed the face in the studio, the impulses from the photo-electric cells lighted in sequence the corresponding

lamps on the screen, so the screen image was truly an image of light.

From the distance of a yard the screen appeared to be a flickering medley of glowing lights, some bright, others dim, always moving, lighting up and dying out without ceasing. But at the appropriate distance the mobile lights ceased to be a series of lamps and took on the image and individuality of the person sitting in the studio.

Viewing the screen from a short distance was equivalent to looking at any picture in the newspapers magnified a hundred times: under such conditions you see the picture merely as a series of big black dots and wonder what they are, but if you walk away from them they appear to grow smaller, until they suddenly merge into a recognizable picture.

What wonders to spring from the brain of a young man while he was too sick and ill to take physical exercise! Baird's success is a veritable triumph of mind over matter; he has given another wonder to the world and brought credit to the land of his birth.

Great developments have taken place since Sir Humphry Davy astounded the Royal Society in 1808 by producing the first arc-light, simply by holding two pieces of carbon close to each other and letting the electric current leap the gap. And there is the promise of greater developments to come.

While we may frankly and freely praise all the workers of other countries who are helping man to harness electricity, we may pause for a moment to consider Great Britain's contribution to the common cause. Gaslight, the arc-light, electric light, Faraday's epoch-making discovery, telegraphy, submarine cables, the microphone, wireless telephony, and television—these are some of the discoveries for which the whole of humanity owes thanks to Britain, and these discoveries should kindle a glow in every British heart.

CHAPTER IX

BRITAIN'S MEDICAL MIRACLES

TO save human life were surely the noblest aim of all, and those devoting all their days to such high ideals must take precedence of kings and princes in the minds of all cultured people. But how many of the myriads who set out in their youth full of good intentions to benefit their fellows, finish life with their aims achieved? Alas, too few! And even the bravest heart will falter under continual disappointments, the strongest man sometimes bow his head in the secrecy of his own room in the darkness of the night. But in the mornings the brave ones set out again on their search, peering into the microscope, wearing out their eyes under the glare of the dazzling white field, hoping, ever hoping.

The majority who are attracted to the medical profession by altruistic motives may find their original conceptions difficult to retain. Going through life on a gradually descending scale as they understand it better, meeting unpleasant facts which sweep away dreams, finding out how the follies and weaknesses of their fellows bring about unnecessary suffering, they may in the end have their own finer susceptibilities blunted and come to regard a noble profession as little more than a business, thinking less of the work and more of the profits. Who shall blame them? Yet in past days many splendid men have all but starved to benefit their fellows, working day after day for a mere pittance. One brilliant research worker told me how he laboured for £90 a year, and how years later he was striving to keep a wife on less than £200 a year. Yet those financial

struggles made no difference to his work ; as the years passed he grew keener, more interested. I shall never forget my surprise, too, when the late Sir James Cantlie told me how he lectured on anatomy at Charing Cross Hospital for seventeen years for £75 a year. The errand boy is paid as much to-day.

The average student, imbued with hope, works on. He must know, if he is possessed of ordinary intelligence, that he will be chained to general practice for the rest of his life, that to one man, perhaps, in a generation, the gods will give the genius and the opportunity of performing something big, something new. What, then, has Britain achieved in this sphere ?

It is generally agreed that the foundations of modern medical science were laid when William Harvey discovered the circulation of the blood. Previously, the strangest ideas existed concerning the functions of the heart ; some people thought it was a sort of furnace which heated up the blood when the latter became cold. They imagined that the blood flowed up and down the same blood vessels, that some vessels were full of gas —the most foolish notions were current before Harvey's time.

Attracted by this great mystery of the heart, Harvey sought for years to solve the problem. He studied shrimps and birds and animals and insects—anything that was likely to throw some light on how the heart works. He sought only the truth, theories were no good to him ; he desired facts, and in due course he found the facts that he sought. After countless experiments he proved to himself that the heart was a pump that forced the blood to circulate through the body, that the blood passed out of the heart through the arteries and returned to the heart through the veins.

In 1615, when he became lecturer of anatomy at the Royal College of Physicians, he began to teach his students how the heart really worked, sweeping away the myths of centuries. He carried out various experiments to prove that what he taught was true. Once

he even took the body of a man who had been hanged and gave a convincing demonstration of how the heart worked and the blood circulated. Even Charles the First was interested enough to watch some of Harvey's experiments, and sensible enough to appoint him as his medical attendant.

Harvey was the type of investigator who announced nothing until he had satisfied himself on the point. Knowing full well that all the ancient teaching about the heart was utterly false, he yet continued to lecture for year after year, telling his students the truth, experimenting to see if by chance he had made any mistakes. Although he was perfectly satisfied, it was twelve or thirteen years after he started to teach at the Royal College of Physicians before he could be induced to publish his great book on the subject. This was dedicated to King Charles the First. That book, *The Motion of the Heart and Blood in Animals*, aroused a storm of controversy which soon degenerated into abuse of Harvey. The latter, upheld by the highest ideals of truth and justice, treated his detractors with courtesy, met their abuse with politeness. He saw his patients leave him one by one, knew that people referred to him as though he was insane and had taken leave of his senses. He accepted these changes with a philosophy that arouses the admiration of all. Perhaps he realized, none better, that to sweep away the old teachings was a bitter blow to the old school, and that nothing new is attained without work and sacrifice. Eventually those doctors who had jeered at his theory were vouchsafed enough common sense to realize that he was right, as posterity has amply proved.

Harvey not only possessed the genius to make a great discovery, and the fortitude to suffer in the cause of truth, but the exact methods by which he arrived at his conclusions were striking enough to indicate that, if medicine was to make any progress, the teaching of fancies would have to give way to the teaching of facts that had been tested and proven true.

Over a century lapsed after Harvey's death before the next great figure was to loom in English medicine. In those days small-pox was one of the curses of life. A foul disease, the outcome of filthy conditions, it left its disfiguring marks on all it touched. Few escaped it, and the most beautiful girls, well-bred, highly placed, suffered equally with those in the slums. Many a lovely girl had her beauty marred by the ugly small-pox scars, many a child was equally disfigured. So common was the sight of faces pitted by small-pox, that they aroused no comment, being regarded largely as a matter of course.

Beauty parlours to-day are legion. Millions of pounds are spent every year by girls who are intent on retaining their good looks and improving them if possible. Hair dyes, henna shampoos, face lotions, face creams, eyebrow plucking, face-lifting—the cult of beauty is now a prodigious industry, despite the fact that so much of it is carried on in secret. But I suppose the greatest beauty doctor ever known was Edward Jenner: he did more than any other man—probably more than all the beauty experts now living—to save the human features from being marred by ugliness. The women of the world, if they but knew, would offer up a prayer to Jenner every night for saving them from the disfigurement of small-pox.

Not that Jenner's aim was to improve the beauty of the race. His sole intention and ideal was to sweep away a disgusting disease—by means which were not unfamiliar to the ancients. The son of a country parson, Jenner travelled to London from the vicarage in Berkeley, Gloucestershire, to study medicine, and proved fortunate enough to come under the influence of the great John Hunter, whose researches did so much to make surgery less of a butchery and more of a science. Hunter was indeed the Master to whom modern surgery owes its inception.

To Hunter the young student mentioned his ideas about small-pox, how the farmers had found out by

experience that if a dairymaid caught cow-pox through milking the cows she never contracted small-pox. A slight rash there might be, but as it soon passed and left the skin unblemished, it seemed of little account, whereas the scars left on those who survived small-pox showed large enough indeed. Of two evils, it was politic to choose the lesser. And to Jenner it was so much the lesser that it was hardly an evil at all. The young Gloucestershire man was advised to experiment, and eventually, when he had taken his degree and settled down again in Berkeley, this is what he did.

His researches left no doubt in his mind, yet plain as were the facts to him, they were not so to his fellow-practitioners. Upon Jenner journeying to London to announce his discovery he imagined that he could hardly fail to receive a favourable hearing. Instead of which the doctors would barely listen to him at all. Those who paused for a moment to study his suggestions usually smiled, if they did not sneer openly or regard him gravely. For a country doctor to visit London to teach medical men their business savoured of effrontery that was unforgivable. Realizing that he was wasting his energy in vain, Jenner returned to Berkeley to continue his researches.

The trump card of the London doctors was always the same. "Have you tested your theory on human beings?" That or its eighteenth-century equivalent.

In old-time fashion Jenner frankly admitted that he had not, and the doctors would remark: "H'm! Rather a pity, isn't it? If only you had tested it on human beings we should have something to go on. As it is, of course, no one can say definitely what will happen."

There was truth in the remarks. Jenner admitted it himself. He had not tested it on human beings, and until he did so, and proved his case, his theory of vaccination would remain a theory and could not be accepted as a fact. In all its aspects he studied the problem for several years more. The human test was the only test

in the end, but before he could bring himself to vaccinate a human being, and then bring the latter into contact with cases of small-pox to see if the disease developed, he sought to remove even the shadow of a doubt from his mind.

So sure was he at last that he took his own little son, only eighteen months old, and vaccinated him in the arm. Here was Jenner's proof to the world that he believed implicitly in his theory. In May 1796, he vaccinated another little chap of eight years old, taking his lymph from the hand of a dairymaid suffering from cow-pox. Apart from a little inflammation on the site of inoculation, nothing happened. Other people were vaccinated by him, they came into contact with cases of small-pox, and remained free of the terrible disease. Then Jenner wrote his famous treatise on the subject, which was published in 1798.

Up to that time Mr. Henry Cline, one of the surgeons at St. Thomas's Hospital, was the only man with the intelligence and acumen to realize that Jenner might be right, and before Jenner's paper was published he had the courage to vaccinate a patient in order to see for himself what happened. After that the whole medical profession was powerless to smother the discovery. The words of one or two disciples of vaccination rang through the land. People clamoured for anything that would protect them from this horrible disfigurement, they demanded vaccination, insisted on it. In five or six years all the nations of the earth acclaimed his discovery. Germany set aside Jenner's birthday as a special feast day; several other countries made it a day of thanksgiving, and processions walked to the churches to offer up prayers for the blessing of vaccination.

In 1802 the House of Commons voted Jenner the sum of £10,000 in appreciation of his discovery, and in 1806 it voted him a further sum of £20,000. For twenty years he had striven to vanquish small-pox, and his great work provided mankind with the method by which the disease was robbed of its power to harm.

From its very inception, however, vaccination has met with opposition, and there are people to-day so bitterly opposed to it that they publish a periodical to wage a regular campaign against it. A few months ago the Ministry of Health suggested that vaccination of people over a certain age should be made only in one spot on the arm, and that a double inoculation should not be given. The reason for this was that several cases of "sleepy sickness" or encephalitis lethargica had seemingly developed after vaccination, and although nothing could be definitely proved, it was considered advisable to advocate a single inoculation.

The evidence that vaccination, if carried out in the proper way with the prescribed lymph at the correct ages, gives immunity against small-pox has been proved time and again. There may be exceptions here and there, but they no more detract from the greatness of Jenner's discovery than the fact that some people become ill if they eat eggs proves that eggs are poisonous as a food.

Jenner may be considered the real Father of Preventive Medicine. He recognized that it was far better to strive to prevent a disease than to aim at curing it, and while it is now generally recognized that prevention is better than cure, there is no doubt that in this respect he was before his time. A doctor in the real sense, he must have been saddened by the ignorance of many of the doctors who opposed him. Still more must he have been sickened if ever he was called upon to witness a surgical operation.

Surgery, I am sorry to say, was little more than butchery. The operating theatre was like a slaughter-house, with patients strapped to tables that were roped to rings in the floor in case the poor victims in their pain could still struggle against the straps. I will not dwell on the agony of undergoing an amputation without an anæsthetic: it is too awful to contemplate.

Viscount Knutsford wrote from the London Hospital to *The Times*: "Here is a grim reminder of what opera-

tions meant before anæsthetics were known. We have a large bell at this hospital which was rung before every operation, and continued ringing till four porters arrived to hold the patient down on the operating table. Rumour tells that every patient who could do so at once left the hospital on hearing it."

How the surgeons did their work at all passes my comprehension. Even the most callous members of their profession must often have been wrung with pity, while sensitive surgeons suffered almost unendurable mental distress. No wonder doctors for centuries had sought something to put the patient to sleep during an operation, something easily administered, that would blot out the sights and sounds and give the surgeon a chance to do his best in quietude unbroken by the cries of the patient.

This was the errand of mercy that James Young Simpson took upon himself to perform. The difficulties were many, but to the young doctor difficulties were made to be overcome. Simpson's life is compounded of romance. Son of a poor Scottish baker, he learned to serve in the shop when quite a small boy, delivering the bread in later years, and showing such an avidity for knowledge that his parents scraped and contrived to send him to Edinburgh University. Jamie was their hero, marked out for great things, and whatever happened they were certain he would not disappoint them.

The boy was but fourteen when he started to attend the University. His attic where he lodged cost 3s. a week, and he was obliged to watch with miser-like glance every penny as he spent it. All his little disbursements were noted in a book, and they make interesting reading to those who care to study them.

His kindly heart and gentle nature nearly drove him to give up medicine after witnessing an operation on a woman, yet the same kindly heart urged him in the end to seek to mitigate such suffering. At nineteen he gained his diploma as a surgeon : he became a doctor without a degree, because they could not give him his

M.D. until he was twenty-one! In another seven years he was elected Professor of Midwifery at Edinburgh, and by the time a further seven years had lapsed he was appointed Physician in Ordinary to the Queen in Scotland. At the age of thirty-five, the son of the humble baker was the Physician to Queen Victoria.

The idea of finding something that would alleviate pain by putting the patient to sleep was ever present with him. He tried one thing after another. Sometimes he made himself ill with his experiments. Once he experimented with two rabbits. They came round all right, and he was going to experiment on himself next day when his assistant suggested that it might be as well to look at the rabbits first. They looked, and found both animals dead! Simpson on that occasion had a lucky escape.

One day he received a bottle of liquid from Professor Dumas, of Paris. Two doctor friends interested in his experiments came to supper, and Simpson produced his liquid and poured a little into three tumblers. Each picked up his tumber and inhaled deeply. They talked as they inhaled, but their talk soon ceased.

When Mrs. Simpson came into the room she found them lying unconscious around the table, and thought that all three were dead. Fortunately, with the assistance of the butler, she brought them to their senses, and Simpson was able to make known to the world his discovery of the beneficent powers of chloroform, for such was the liquid which they inhaled in so foolhardy a manner.

Sadly enough, the kindly Scotsman was reviled for easing the pangs of child-birth, but he was able to crush his opponents and give to surgeons and physicians the power of easing pain in the greatest crises of life. Twice he refused a title, but on the third occasion he bowed to the wishes of Queen Victoria and accepted a baronetcy. If the Queen of England honoured him, she added a greater honour to the name of Britain.

It was Humphry Davy who first found out the

powers of nitrous oxide, now commonly known as laughing gas, in 1798, and although he had seen cats and rabbits and rats and insects die in a few minutes after inhaling the gas, he possessed the courage which enabled him to try it on himself in order to reveal how it would affect human beings. At his first attempt he breathed five quarts. "Sometimes I manifested my pleasure by stamping or laughing only; at other times by dancing round the room and vociferating," he wrote in his book, *Researches, Chemical and Philosophical*, which was published in 1800. And at the end of that book were these remarkable words: "As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place."

The doctors were blind to the wonder that Davy held out to them. In 1818 Davy's famous assistant, Michael Faraday, wrote, after making experiments: "When the vapour of ether mixed with common air is inhaled it produces effects similar to those occasioned by nitrous oxide."

Still the doctors were blind—all except one, Henry Hickman, who was the first medical man to prove the value of anæsthetics by actual operation on an animal. In 1824 he wrote a pamphlet which he sent to a former President of the Royal Society: "A letter on suspended animation, containing experiments showing that it may be safely employed during operations on animals, with the view of ascertaining its utility in surgical operations on the human subject."

Hickman was as a voice crying in the wilderness. No one took any notice, not even the great Sir Humphry Davy, who had first made the glorious suggestion. So the young English doctor went to Paris to present his paper to the French Academy of Medicine, but the Frenchmen proved to be as blind as their English medical confrères, and, after fighting in vain against the apathy of the medical profession, he came home to die at the

age of twenty-nine. Had the world listened, anæsthetics would have come into use twenty years earlier, or about the time that Simpson was entering Edinburgh University as a boy of fourteen.

In the words of Lord Dawson of Penn : " Hickman, though a young country practitioner, had the mind to see, the heart to feel, what anæsthesia meant to humanity —and strove to move his profession in England and France to action. Honour is his due, and it is our privilege and happiness to perpetuate his fame."

While Pasteur's outstanding genius revealed to medical science an entirely new world of microbes, it was left to the genius of the Quaker surgeon who became Lord Lister to utilize the new knowledge to save the lives of suffering people.

Gangrene had always been the dread of the surgeons. Even when they were able to give the patient chloroform and operate more quickly and efficiently, they so often saw the onset of that dread festering which led to death. The proportion of mothers who lost their lives in giving birth to children was pitiful and alarming.

The sheer horror of it all, the helplessness of doctors and surgeons, was brought home to Lister on his appointment to Glasgow Infirmary in 1861. The gross carelessness of doctors and nurses was appalling. He insisted on them washing their hands and attaining some degree of cleanliness in attending to the patients, with the result that the directors of the Infirmary called him on the carpet for using so much soap ! It would be laughable if it were not so tragic.

Cleanliness, however, became the order of the day, the while his mind grappled with the problem of those so-called successful operations which cost the patients their lives. He cast round for a cause, sought a cure. Night after night he read many works to see if he could find a glimmering of light. His search was carried on for months, for years. Then, four years after going to the Infirmary, he was reading a publication of Pasteur's on Researches on Putrefaction in the Academie des

Sciences and he came on the phrase " putrefaction is caused by living ferments."

The phrase to him was like a searchlight, and when he had finished that paper, the whole problem of gangrene clarified in his brain. The disease was caused by living germs that were all around. It was these invisible organisms getting into the wounds from outside—conveyed, perhaps, by the touch of a nurse's or doctor's dirty hand in dressing the wound—which multiplied until they killed the patient. If only he could find something to kill these germs, then he would be able to save the lives of the sufferers.

How Lister eventually discovered the germicidal properties of carbolic and worked out his antiseptic treatment of wounds is fully described, along with the whole thrilling romance of medical discoveries, in my book *The Conquest of Disease.* Lister suffered the most bitter attacks, like Harvey, Jenner, and Simpson, and, sad to relate, Simpson ranged himself on the side of those who were too blind to see the fundamental truth in Lister's magnificent discovery. But in the end truth prevailed, and the antiseptic treatment was recognized as a boon of the first magnitude.

To quote the words of the American Ambassador at a banquet given to Lord Lister by the Royal Society : " My Lord, it is not a profession, it is not a nation, it is humanity itself which with uncovered head salutes you."

Antisepsis has now given way to asepsis, but the glory of Lister will never be diminished.

It was left to the county of Aberdeenshire to produce the figure which towers like a colossus in Medical Science, equalling perhaps the mighty Pasteur who added so much to the fame and wealth of France. This was Patrick Manson, the son of the laird of Old Meldrum. The bright side of sickness is seldom seen, but to the world that weakness of the spine which laid Manson on his back as a youth and prevented him from becoming an engineer in the works of his grandfather was one of the greatest blessings known.

For two hours a day Manson was able to get up, and during these two hours he went to Marischal College, Aberdeen, and studied botany and zoology. Then, finding that these two subjects came within the medical course he, like a true Scotsman, concluded that it would be a pity to waste the two sessions he had attended, so he decided to continue and become a doctor ! Studying at Aberdeen and Edinburgh, he passed all his examinations, like Simpson, before he was twenty, and like Simpson had to wait until he was twenty-one before his degree could be granted to him. A mere boy of twenty-two, he was landed in a small boat on a beach in Formosa to take charge of the Chinese hospital there, and there, in the East, after years of study, he found the key which is making the tropics safe for the white man to live in.

One of the commonest diseases he met with was elephantiasis, in which the legs and other parts of the body swell to an enormous size. Nobody knew what caused these swellings until Manson, reading of the discovery by Lewis of the filaria worm in the blood of a man, wondered if this same worm caused elephantiasis. He found out that it did.

Many men might have rested content with that discovery, but not so Manson. If the cause of the disease had been unmasked, there was an even greater mystery still to be revealed. How did those minute worms get into the blood ?

A year or two before he died he honoured me by telling me the story of his great discovery, but it needed all my persuasive powers to induce him to speak. " I knew the filaria worm could not walk," he said. " It could not fly. It was locked up in the blood and body of a man as securely as a convict is locked up in his cell in Dartmoor. I sought the key that unlocked the worm from the body of the man. The worm itself was helpless. Some other agency transferred it from the blood of one man to the blood of another.

" I considered many things, and at length came to the conclusion that one thing alone was responsible.

That thing was the mosquito. In certain parts of China a large proportion of the population harbour the filaria worm in their blood. I tested the blood of one or two of my servants, and found that one of the boys who carried my chair was heavily infected. I took him to a room screened with mosquito netting.

" ' If you will sleep in this room and let the mosquitoes bite you, I will give you a dollar, John,' I said. He readily agreed, so I let in a batch of mosquitoes and fastened the door on him. The next morning I went in. He was still asleep, and there were several insects gorged with his blood hanging from the walls in their well-known attitude. I took a tumbler and placed it over one ; then I slipped a piece of paper between the glass and the wall, puffed a little tobacco smoke from the pipe I was smoking into the glass, and thus rendered the insect drowsy, and was able to place it in a small phial covered with gauze. I treated perhaps twenty insects in this way, and when I came to dissect them and examine them under the microscope, I found they were all infected with live filaria worms."

This discovery of Sir Patrick Manson's in 1877 was the first scientific proof that insects spread disease. Unknown to him, other men in other times had advanced this theory to an unbelieving world, but this does not lessen his genius in the slightest. Where Pasteur proved that diseases were caused by bacteria, Manson revealed the deadliness of insects to the human race ; his was the master-mind which led us to discover that many diseases are carried from one human being to another by the insects which creep and leap and fly.

Medical men thought he was mad. They refused to believe anything so revolutionary. More than once he saw them give a significant tap to their heads as he passed. " There goes Mosquito Manson ! " they would say. The Scotsman, great-hearted, simple-minded, chuckled with delight as he recalled those days. He knew that they laugh best who laugh last, and he not only founded the London School of Tropical Medicine,

but he was the true Father of Tropical Medicine and his genius opened an entirely new field of research.

No one knows the difficulties he met with in carrying on experiments in the East, the makeshift apparatus he was driven to construct and use. On one occasion he was anxious to grow some germs, for which purpose an incubator was essential, but there was none within hundreds of miles. Puzzling his wits over the problem, he fell back on the most primitive incubator of all. Buying a broody hen from a native, he inserted his tiny tubes of cultures into some eggs, placed them under the hen and used the bird as his incubator. This amusing innovation was a brilliant success, and, so far as I know, it is the only instance in medical history where a hen has been made to mother germs in this way !

In 1894 he suggested in the *British Medical Journal* that the mosquito was responsible for spreading malaria, one of the most widespread of diseases which has claimed untold hosts of victims, and Sir Ronald Ross, to whom Manson accorded every assistance, returned to India determined to solve the mystery.

Ross toiled like a giant at his self-imposed task, in conditions that were well-nigh impossible. " The work, which was continued from 8 a.m. to 4 p.m., with a short interval for breakfast, was most exhausting, and so blinding that I could scarcely see afterwards," he wrote ; " and the difficulty was increased by the fact that my microscope was almost worn out, the screws being rusted with sweat from my eyes and forehead, and my only remaining eye-piece cracked, while swarms of flies persecuted me at their pleasure as I sat with both hands engaged at the instrument."

For two years, in these horrible conditions, he faced failure day after day before success rewarded him.

" On August 20, I had two remaining insects, both living. Both had been fed on the 16th instant. I had much work to do with other mosquitoes, and was not able to attend to these until late in the afternoon, when my sight had become very fatigued. The seventh

dapple-winged mosquito was then successfully dissected. Every cell was searched, and, to my disappointment, nothing was found until I came to the insect's stomach. Here, however, just as I was about to abandon the examination, I saw a very delicate circular cell, apparently lying among the ordinary cells of the organ, and scarcely distinguishable from them. Almost instinctively I felt that here was something new. On looking further, another and another similar object presented itself. I now focused the lens carefully on one of these, and found that it contained granules of some black substances, exactly like the pigment of the parasites of malaria. I counted altogether twelve of these cells in the insect, but was so tired out with the work and had been so often disappointed before that I did not at the moment recognize the value of the observation. After mounting the preparation, I went home and slept for nearly an hour. On waking, my first thought was that the problem was solved, and so it was."

So in 1897 Manson's predictions were verified, and Ross found the parasite of malaria in a mosquito. For sheer, painstaking effort his feat has never been surpassed, and the Nobel Prize and a knighthood were some measure of appreciation conferred on him for his brilliant work.

The story of how Dr. Louis Sambon lived in a screened hut in the malarious Campagna of Italy, and how Manson's own son volunteered to allow a mosquito to infect him with malaria in order to sweep away all doubts, is full of thrills, but its place is not here. Sambon himself, who first named the tsetse fly as the insect carrier of sleeping sickness, was disbelieved when he suggested that the body louse carried a certain fever known as Rocky Mountain fever, but he has since received ample justification in the proof that the louse not only carries the deadly typhus fever from one human being to another, but this same filthy creature was also responsible for the outbreak of trench fever during the war, as the three British investigators,

SIR RONALD ROSS, WHO UNMASKED MALARIA, ACHIEVED A SCIENTIFIC TRIUMPH FOR BRITAIN. THIS PHOTOGRAPH SHOWS SIR RONALD AND LADY ROSS OUTSIDE THE INDIAN LABORATORY WHERE THE SECRET OF MALARIA WAS LAID BARE. THE QUAINT WICKER CAGES CONTAIN THE BIRDS WHICH SIR RONALD USED TO SOLVE THIS MOST DIFFICULT PROBLEM

Dr. M'Nee, Dr. Brunt, and Dr. Renshaw, so cleverly demonstrated.

I cannot bring this chapter to a close without briefly mentioning one of the noblest women who ever lived, the English lady who spent her energy and strength in trying to bring a little humanity into war. The facilities for dealing with the wounded during the Crimean War were as bad as they could be. The men struck down on the field of battle had little chance of recovery, for forty-two out of a hundred were practically doomed. The jobbery that went on during the war, the rotten boots and stores that were sent out to the troops by dishonest contractors, were a national disgrace, but the biggest disgrace of all was the way the wounded were left to wallow and die in their misery.

Florence Nightingale, whose sympathy for the sick had compelled her to turn her back on the easy life of a society girl in order to study nursing, gathered a company of forty nurses and hastened to Scutari, opposite Constantinople, to nurse the wounded in the hospital there. She brought the death-rate among the wounded down to two in a hundred, and because she used to go round the beds at night with a lamp in her hand, ministering to the wants of the poor soldiers, she became known as the Lady with the Lamp.

Britain subscribed £44,000 for her, but instead of accepting it, she founded the Nightingale Nursing School for training nurses at St. Thomas's Hospital, so that the good work for which she lived could continue. Ruined in health by her ceaseless efforts, she avoided the great reception planned for her, and went quietly home to her father's country house.

Florence Nightingale by her example stirred the conscience of the nations and forced them to realize that it was their bounden duty, once a man was wounded, to do everything humanly possible to ameliorate his sufferings and nurse him back to health. She forced the Powers to realize that when they set out to kill and maim on the battlefield they must prepare and organize to

salve and save the human wreckage they created. To Florence Nightingale all wounded were the same; no longer were they friends or foes, but all alike the objects of tender care and compassion.

This one Englishwoman with her wide sympathies and forceful character prepared the way for the signing of the Geneva Convention, which placed ambulances, bearers, nurses, and doctors under the sign of the Red Cross and ordained that it should be inviolate, wherever it moved in the field, but it was a Genevese doctor, inflamed by indignation and pity at the horrors of Solferino, who brought the Geneva Convention to pass.

When the whole tale of medicine is told, Britain has made a magnificent contribution to the cause of humanity. These little islands have produced geniuses whose discoveries are unmatched by those of any other nation on earth. I salute our healers. They have ennobled not only Britain, but the whole of Mankind.

CHAPTER X

SOLVING SOME BAFFLING MYSTERIES

WHILE the opinion is widely held that we are a nation of money-grubbers, who bend our energies only to those things which show a handsome direct profit, we nevertheless breed individuals who completely falsify this continental theory. What shall it profit a man, for instance, to dig up a dead civilization or devote all his intelligence and nervous force to elucidating writings that all human beings have long since ceased to know how to read? Are the men who do these things just money-grubbers? The facts go far to refute the contention. It is a common saying, that it takes all sorts of people to make a nation. Where you find good, there you will find bad; and where you detect people who love money, there also you may find those who disregard it. No nation is wholly good nor wholly bad, and to call the British nation a nation of money-grubbers was far from the truth yesterday, and it is further than ever from the truth to-day. Indeed, the Americans, the French, the Italians, the Germans, the Belgians have shown themselves to possess a far greater love for money, with a far smaller regard for real culture and civilization, than the British race. The facts exist, and later they will prove my contention. As a race we possess enough sense of humour to laugh at ourselves. But because we laugh at what we consider a good joke, instead of protesting vehemently against certain slanders, other nations have come to look upon those slanders as truth. Henceforward it will prove better for the British nation to refute these calumnies, rather than let them pass with a smile of amusement.

To suggest that Dr. Thomas Young sought profit is not true. That he sought knowledge for its own sake is obvious, and that he aimed to decipher the pictographs and hieroglyphics of ancient Egypt in order to add to the culture of his time is apparent. But what is not usually apparent is the magnitude of the task which he undertook.

The tombs of Egypt disclosed papyri which were covered with the quaintest little pictures imaginable, queer figures of men and women, with all sorts of foodstuffs and animals and beetles which bore the indication that they were much more than the idle sketches of an ancient artist in his spare time—that they were in fact intended to convey some meaning. What that meaning was, no living man had the faintest idea. These little pictures and other characters were a perpetual challenge to man, one of the most difficult problems he has ever faced ; they seemed to defy anyone to read them.

There was not the slightest clue to go by, until the Rosetta Stone was dug up. Scholars found the whole surface of the stone covered with closely engraved characters of three different types. As one set proved to be Greek, these characters were soon translated and disclosed a decree of Ptolemy V., dating about 196 B.C.

Whether the stone was engraved with one decree three times in different writing, or whether it contained on its surface three decrees, nobody could tell. Among the men who puzzled their heads over the problem was a medical practitioner, Dr. Thomas Young, who took an exceeding interest in dead languages. This piece of black stone intrigued him. For long hours he pored over the stone itself and then went to his study to pore over the copy which he had, and at last he was able to furnish the first clue to the past.

In the top section of the stone covered with the unknown hieroglyphics was a series of characters, repeated in two places, and surrounded by a line. In the Greek text the name of Ptolemy was twice mentioned, and Young reasoned, quite logically as it hap-

pened, that the characters with the line round them stood for the name of Ptolemy. We learned later that the name of a king of Ancient Egypt was always surrounded by a line in this way: it was the royal cartouche.

Thus a start was made. But the rest of the problem was a mass of difficulties. It was simply impossible to make sure whether the other characters represented whole words, letters of a word, sentences, or just the objects which were engraved there, or sounds. Nor could anyone tell if they were a combination of these possibilities. Of one thing Young was sure: the hieroglyphs concealed a meaning to those who could read them, and the very difficulties of the task seemed to urge him to wrest the secret from the black stone.

In 1814 he concentrated all his energies on the project and, after working a week or two, deciphered a character. It seemed a hopeless endeavour, yet as the months drew out to years, he saw the sum of the total slowly growing. Sometimes for weeks or months he could achieve no result at all, then, deciphering a few characters which his tests indicated must be correct, he would attack the problem with renewed energy.

Once he thought he had translated a set of hieroglyphics into a word of seven or eight characters, but when his result was tested, it was palpably wrong. Still the one character which was undoubtedly right, was one more link in the chain that Young sought to forge to connect the present with the past.

He was an unusual man, possessed of the most extraordinary abilities, with a gift for languages that amounted to genius. The son of Quakers, he was born on June 13, 1773, in Somerset, and his grandmother and aunt with whom he lived instilled so much knowledge into his brain that at the age of nine he was something of a prodigy, reading Greek and Latin easily. Unlike most prodigies, his talents did not bloom early and straightway decay. On the contrary, they continued to develop as the years went on, and allied to his unusual talents

was a pertinacity not usually found in one so blessed. It was as well, for his tutors at school did not possess the teaching ability of his relatives, and the boy went straight to the most difficult of books to gain knowledge for himself, his wonderful memory and industry giving him command of fourteen different languages when he was fourteen. At this age his wide knowledge enabled him to become the tutor of others and thus earn some acceptable fees.

Studying in Edinburgh, Germany, and Cambridge, he took his medical degree, a fortune left to him by an uncle making it unnecessary for him to worry now about financial considerations. Working on the science of sound, he was led thereby to infer that light was composed of waves, which theory was very different from the corpuscular theory of the mighty Isaac Newton.

For years he lectured at the Royal Institution, then he went to St. George's Hospital and threw himself heart and soul into medicine. He was forty-one when his mind was suddenly filled with the desire to wrest the secret from the Rosetta Stone, and after four years of incredible toil he was able to point to only one hundred characters as the sum-total of his labours. With all his genius, he was able to translate on an average only two characters a month !

Few men would have had the heart to continue a task which yielded such meagre results. But Young kept on. He knew that he was opening a new door into the Past, that his endeavours would be of profound assistance to others. And in this he proved to be right.

Actually the Rosetta Stone was found to consist of the same inscription, in Greek, the ancient hieroglyphics of Egypt, and the popular Script of Egypt. Baffled by many of the characters on the stone, Young obtained papyri and copies from which he managed to elucidate another hundred characters. He published a popular account of his work in the *Encyclopædia Britannica* in 1819, and two years later Champollion, the Frenchman,

published a paper in which he admitted that he could not solve the meaning of these strange writings.

Champollion in after years did wonderful work in this particular sphere, but he besmirched his own honour and that of France by stealing the results of Young's work and publishing Young's results under his own name in 1828. Directly he published his first paper saying he could find out nothing about the characters, Young's discoveries in the *Encyclopædia Britannica* were brought to his notice, and the Frenchman immediately withdrew his own paper confessing his ignorance, and later annexed to himself the credit for Young's translations! It was Young who out of his own talent fashioned the key which unlocked this door of the past, and Champollion took that key and sought to purloin the credit for fashioning it. Young died in 1829, but it was half a century before his genius began to receive any recognition at all, and even now the full magnitude of his accomplishments remains comparatively unknown to the general public.

For some years past Mr. Leonard Woolley and his colleagues of the British Museum and the University Museum of Philadelphia have been removing mountains of sand at Ur of the Chaldees, in Iraq, as we must now call ancient Mesopotamia. And from time to time little clay cylinders and tablets are brought to light filled with the curious little imprints which seem to suggest that a blackbird or robin may have hopped over them while they were still wet. These clay pages from the book of ancient history are written in cuneiform writing, and a century ago no living man had the faintest idea how to read them or what they meant. They were a lost writing of an unknown people.

I fear, if it be suggested that Englishmen are sometimes peculiar, that I would assent, if by peculiarity is meant that an Englishman may occasionally risk his life for things which appear to be most unprofitable or ridiculous. On these terms we may frankly admit that Sir Henry Rawlinson was peculiar, for who would expect

a soldier to devote his spare time to unravelling the secrets of a dead language?

Like Young in his ability for languages, Rawlinson was rather a paradox. At heart he was a student, and by profession a man of action. At the age of seventeen, the young soldier went to India, and acquired such an uncanny control of native dialects that at twenty he was general interpreter in the army of the East India Company. A few years later he was speaking Persian so perfectly that the natives could not tell him from one of themselves when he was dressed in native costume. In consequence, he proved to be the very man to reorganize the Persian Army for the Shah. He turned it from a rabble, rotted by corruption, into a drilled force; he saw active service on the frontiers, spent a time in the Court of Afghanistan, but in 1835 he went to Kermanshah to command all the troops in this province of Persia.

Twenty miles away was a mountain, and some three hundred feet up on its face were a number of quaint carved figures and panels of what appeared to be some sort of writing. Nobody knew how old the sculptures were, for, after they were finished, the masons had cut away all the rock below, to leave no foothold for vandals who might design to destroy their work. Such was the Rock of Behistun, which took hold of the imagination of Rawlinson. He rode out there day after day, climbed that escarpment, and slowly copied out the inscriptions. A slip and he would have broken his neck, as the ancient masons had intended, yet he calmly made his way up and down three and four times a day.

When the time came that he had to mount a ladder to copy the inscriptions higher up, he found the ledge at the base of the sculptures so narrow that the ladder was almost perpendicular, and the least movement outward would have dashed him to his death. He did not seem to trouble. Balancing himself precariously on the rungs, he made his copies, went home to his meals, and returned in the afternoon. Then one day he had to get across a gap to the other side, and the rock was so

shaped that he could not place his ladder flat; therefore he arranged it on its side, with the lower side hanging free over the chasm and the upper side firmly lodged on two projecting ledges. Clutching the upper side, he placed his feet on the lower side and began to work his way over. Without any warning, the whole of the lower side of the ladder with the rungs was pulled out of the upper side by his weight. As he was dropping into the chasm, he managed to get a good grip of the upper side, and dangling by his hands, with death below him, he slowly worked his way back to safety. Had he died at that moment it might have been many years before the world learned to read cuneiform writing.

There were actually three inscriptions on the rock, just as there were three inscriptions on the Rosetta Stone. But on the latter the Greek did at least serve as some guide, whereas at Behistun all three inscriptions—ancient Persian, Median, and Babylonian—were unknown. There was simply nothing to go by. It was in the Persian inscription that Rawlinson found his clue, and as in the Rosetta Stone it was the name of two kings. From that slender clue the unknown writings were gradually deciphered, and the draft of his famous book was prepared.

Then for seven years he had to leave his beloved Persia to fight the Afghans and concentrate on martial duties, before he could come back as Consul at Baghdad to take up his studies once more. Dissatisfied with the copies he had made, he now sought a proper set to be made by rubbing thick damp paper into the impressions on the stone, but it was some time before he discovered a brave little Kurdish boy who would volunteer for the job. The lad accomplished his task by driving long wooden pegs into the soil, and by manipulating a rope he managed to fix another peg from which he suspended a cradle, and in ten days he copied the whole of the inscriptions on the rock.

Rawlinson later sat with a pet lion at his feet, and a water-wheel pouring water over the roof of his summer-

house to keep it cool while he worked at deciphering the characters. In 1846 the Royal Asiatic Society published his great book containing his reading of the inscriptions of Darius, the Persian king who lived about two thousand four hundred years ago, with the result that many imagined Rawlinson to be a charlatan, who had simply made up something out of his own head; it was argued that no man could read a writing to which not one single recognized clue already existed.

The great test came when a clay cylinder was dug up in Mesopotamia and copies of it were handed out to four scholars to see what it said, according to the work of Rawlinson. Had the latter just made up some code out of his own head, it could not have made sense of this unknown cylinder, so when the four translations came in and were in agreement, the wonder of Rawlinson's work was justified and acknowledged.

Sir Henry Rawlinson himself always attributed his success in his task to his profound knowledge of all Persian dialects, which enabled him to get to the roots of words that absolutely baffled others, so he learned that throughout all its changes the living tongue still contains some trace of the language of long ago.

As for the men who have actually dug the past out of heaps of debris, the greatest, inasmuch as he was the first, is undoubtedly Sir Henry Layard, who began life by studying law, and finished by revealing the lost palaces of the Assyrians and the Babylonians. And the incredible thing is that he began his excavations with the paltry sum of £60. He seemed to sense the glories that lay under those great mounds in the deserts—mounds to which Time had given the contours of natural hills. But something—a mixture of intelligence and intuition—told Layard that here he would find the remains of many of the old peoples mentioned in the Bible.

A born traveller, he appeared instinctively to understand the Oriental mind, knew all its crazy workings and its treachery, and withal possessed the power to command the respect of the nomads of the desert. All the

time he dug, his life was in danger from marauding tribes; often he had to suffer from terrible bouts of malaria; yet even when stricken in this way he aroused such respect that his diggers went on working.

The day one of the great winged bulls, now in the British Museum, was uncovered, he gave a great feast to the workers and the people round about. The tribes wandering about the desert with their hair tents could have wiped him out; often an attack seemed imminent, yet he had no fear. He would go boldly to their encampments and dominate the chiefs in their own tents, thus winning safety for himself and unhindered working for those he employed.

Under thirty feet of debris at Kouyunjik, Layard found the palace of King Sennacherib himself, and drove tunnels in all directions through the labyrinth. He slaved on week after week while light lasted, copying inscriptions, making drawings of the sculptures, marking out with uncanny skill the places where his men were to dig. In this latter respect he seemed to the natives to have second sight. Where they saw only a fold in the ground, he would point with his stick and say: "A wall runs here. There you will find a courtyard, and perhaps some figures." And sure enough, after several days, the Arabs would uncover the things that he had prognosticated were there. They came to regard him with awe, especially when he told them the sun would be blotted out on a certain day—he knew there was going to be an eclipse—but he was compelled to do anything and everything that would impress them and make them treat him with respect, otherwise they would have slit his throat with as little feeling as they slit the throat of one of their lithe sheep or goats.

Thus this unusual Englishman, sleeping alone in the ruins of the desert where wolves were sometimes seen and lions were not unknown—indeed, one of the most embarrassing presents he ever received was an extremely unruly lion from a kindly disposed Turkish notability—fought with the sands in order to make the lost civiliza-

tions of Assyria and Babylonia live again. Fables were only words, after all, but the statues these ancients carved were so tangible that no one could doubt the existence of the men who carved them.

His days were full of difficulties which he had to solve alone. It was not easy, in the first place, to obtain from the Turks his concessions to dig, and the Turks were often definitely obstructing him; so much so, that on one occasion he had to man his diggings with armed Arabs to beat off attacks. Once the Turkish military actually took possession and stopped all digging. Layard, growing very friendly with the sentries, put them on his pay-roll and got them to oversee some of the work. It is amusing enough now, but it was a serious matter to him, for his heart was set on recovering as many sculptures as possible and getting them to England.

One of his biggest problems was to transport his finds to the coast. There were no trees in the desert, yet timber was essential to his purpose, so he had to send men several days' journey up into the hills to fell mulberry trees and float them down on the Tigris to his camp. The timber formed the bases upon which he could rest his sculptures, but the timber alone was not sufficiently buoyant to support the stone statues. He was thereupon driven to obtain hundreds of sheepskins and goatskins. These were duly inflated by the mouths of his helpers, and then formed into compact rafts, upon which the timber was secured, and in this primitive fashion the relics were drifted on the current of the river to the sea.

Thus it was that a young lawyer on his way overland to Ceylon to practise law stopped by the way in the wilds of Mesopotamia and recovered all those wonderful sculptures now to be found in the British Museum, the relics of Assyria and Babylonia, while a young soldier gifted with a genius for native dialects performed the almost superhuman task of learning how to read unknown writings that told of the rise and fall of Assyria and Babylonia, a thrilling story that is still being unfolded by our own archæologists.

THE TOMB OF TUTANKHAMEN DISCOVERED BY MR. HOWARD CARTER PROVED TO BE ONE OF THE GREATEST ARCHEOLOGICAL DISCOVERIES EVER MADE IN EGYPT. THIS PHOTOGRAPH GIVES A GOOD IDEA OF THE UTTER DESOLATION OF THE VALLEY OF THE TOMBS OF THE KINGS; THE X SHOWS THE WAY DOWN TO THE TOMB, WHILE THE GUARDS ARE SEEN ABOVE.

Important as the French excavations in Egypt have proved, it is again an Englishman, Sir Matthew Flinders Petrie, who swept away the haphazard methods of the French and other archæologists and introduced science into this field of exploration. Petrie was not satisfied to find things; he wanted to know how they were found, the depth at which they had been uncovered, what other things were found with them at the same level, what was above them and what below them. To him everything was important, and the finding of the tiniest fragment of glass in conjunction with a broken bit of pot might throw more light on the past than the uncovering of a palace. The least little thing was noted, for he taught the archæologists that little things may form important links with the past and help to a better understanding of the vanished civilizations.

Once an Arab in Gizeh offered part of an alabaster statuette to Petrie. "Where did you get it?" the archæologist asked, paying the Arab for the piece. The native told him, and the famous Egyptologist hastened by train to the nearest point, and then trudged twenty miles over the desert, where at last he came across a series of mounds. Bits of broken pottery lying about told him that here in the past a city had existed, and when he brought his labourers to dig there at a later date he saw two bits of stone lying on the spot where he was about to make a shelter for himself. He turned them over and found a proclamation of the lost city of Naukratis, a city which many scholars swore was just a myth! It was a tremendous discovery to hang by so slender a thread.

Nor has any man, to my knowledge, had so weird an experience as befell Petrie when he discovered the mummy of a noble at the bottom of a well. Down he went with his helpers and struggled to remove the blocks of stone sealing the chamber containing the sarcophagus. When he found the sarcophagus under the water, he took weeks cutting it in halves. The men were up to their chests in water struggling in the blackness for day

after day, and in the end Petrie himself had to get into the other half of the sarcophagus with the water up to his mouth, breathing through his nose while he sat astride the coffin and struggled to loosen it sufficiently to haul it out. For days he fought with it, more than once taking a mouthful of that foul water, and in the end he had to drill holes in the coffin, fix bolts, and drag it up. They found Horuta's mummy "wrapped in a network of lapis lazuli, beryl, and silver," with many amulets and other treasures—as thrilling a find as ever fell to archæologist.

The story of this and other remarkable discoveries is fully set forth in my book, *The Romance of Excavation.* I cannot, however, leave this chapter without touching on Mr. Howard Carter's discovery of the tomb of Tutankhamen, which surpasses everything ever discovered previously.

Many years ago, Howard Carter found the tomb of Queen Hatshepsut, high up on the rocky face of the mountain, and it was no pleasant nor easy task removing the mummy of the lady whose Temple occupies such a vast and important site in the Valley of the Kings. He had been hoping some day that he might come across the tomb of Tutankhamen, but there are few men who have his satisfaction of seeing a dream come true. The scene inside the tomb was one of the most dazzling sights an archæologist has ever beheld, and Lord Carnarvon, when the inner shrine was entered, must have felt that the fortune he had devoted to excavation was not spent in vain.

Carnarvon was a man born to fortune, who might have frittered away his time and money in the usual society way. Instead, he chose to take an interest in archæology, and apply his wealth to widening the boundaries of knowledge. It was sad that a tiny scratch should lead to septicæmia and death just after the fulfilment of his visions of doing something really outstanding.

There is another Englishman, Sir Arthur Evans,

who has spent the greater part of his life digging at Knossos in Crete, unearthing a civilization that was before Greece. Countless are the finds made by his labourers, and many are the ruins he has uncovered and restored. But the most fascinating finds of all are those inscriptions which no man has yet succeeded in reading, for they are in the unknown characters of an unknown race. That the people possessed a fairly high degree of culture is made plain by Sir Arthur's discoveries, but the full story of how their civilization flowered and vanished can only be told when the inscriptions are deciphered. Sir Arthur has worked on them for years. Considering that Young and Rawlinson were successful in solving problems as difficult, there seems reasonable hope of Sir Arthur Evans achieving his aim in the end.

Such men, quiet, highly intelligent, resourceful, who labour in distant places solely to add to the culture of the world, are a perpetual disproof of the slander that the English are a nation of money-grubbers.

CHAPTER XI

PIRATES AND PIONEERS

WHO shall explain the lure of exploration? Is it curiosity so strongly developed that it drives a man to attempt the impossible? Is it but the desire to find fortune, or fame? Whatever be the moving spirit, the facts indicate that the English have more than their fair share of it, even if they have no monopoly.

Robert Louis Stevenson comments on that curiosity which lures you along a winding road, and keeps on luring you along a little farther just to see what is round the corner. It is the spirit which sends people up a hill to see what is beyond, a spirit to which most people succumb at some time or another, generally earlier than later.

None the less is he a brave man who takes his life in his hand and ventures in a small craft on an unknown sea to discover unknown lands in the hope that a rich reward awaits him. To Sir Francis Drake the reward probably loomed fairly large. Content to add to the glory of England, he was willing to do so provided it proved profitable to himself. It was undoubtedly profit alone that beckoned to Drake to go on those bold expeditions to the Americas, and it was revenge that brought him back there to spoil the Spaniards.

With all due deference to patriotic feelings, there is no doubt that Drake was as bold and bad a free-booter as ever sailed the seas. Born near Tavistock in 1540, he learned all the tricks of the sea and tides off the English coasts as a youth, and the chance came at the age of twenty-seven for him to control one of the

ships of Sir John Hawkins, who had been on a paying slaving expedition to the West Indies three years previously, and now in 1567 was returning with Drake to the scene of his former exploits.

They were nothing but thieves and pirates, but in fairness it must be said that the Spaniards were no better. Spanish or English were always ready to sink a ship or sack a city ; they had no hesitation in killing or murdering, so long as there was plunder to be gained. Evil deeds are the outcome of lawless times, in which courage stands out and flames the brighter.

The Spaniards fell on Sir John Hawkins' fleet at St. Juan de Lua and all but wiped it out. Only two ships escaped disaster, and one was commanded by Drake. Little the Spaniards knew the bitter feelings in the Devon man's heart as he sailed away. That defeat and the desire to avenge it were thenceforward the dominating factors in Drake's life. He desired wealth, but above all he nursed his hatred for the Don.

That was a strange period. While the English and Spanish courts were quite friendly, and Elizabeth and Philip were perfectly polite to each other, every time the two peoples met at sea they would have a little war of their own. Cortez, having conquered Mexico without the slightest excuse for warring on the people except that he desired to rob them of their treasure, had plundered vast hoards of gold and silver and sent a deal of it back in the caravels of Spain, and twenty years after the death of Cortez the rumours of the treasure still to be found in the cities of South America fired the imaginations of all seamen. So Drake, after this ignominious defeat, nursed his own thoughts of relieving the Spaniards of their gold. The State could not help him to right his supposed wrongs, so he calmly sailed away again to reconnoitre the position and see how he could right them himself. He returned safely and again went out, and when he came back this time he fitted out two " shippes." He had but seventy-three men, and stowed in the ships were three pinnaces which

he proposed to put together when he arrived on the scene of his exploits and use them for landing purposes and exploring along the shallow shores. A pinnace could go where a big ship could not follow, and Drake was cunning enough to realize the advantages he gained thereby.

Arriving off the Mexican coast, he led his little band ashore, and captured Nombre de Dios, where he found a dazzling treasure of gold and silver and jewels. Luckily for themselves, the Spaniards managed to wound him, and his men, lacking the courage of their leader, beat a retreat, carrying Drake with them, but leaving the treasure behind them, much to his chagrin. For a while he lay low to allow his leg to heal, then he set out again, taking a ship or two, and capturing Venta Cruz on his way back from the other side of the isthmus, whence he gazed for the first time on the Pacific Ocean.

For a pirate and cut-throat, he was certainly endowed with a strange religious feeling, for as he gazed he prayed that " Almighty God in His goodness might give him life and leave to sail once in an English ship in that sea." Then he set out for Plymouth, where he dropped anchor in August 1573. As soon as his ship came in, the news of his return spread through the town, and, it happening to be the Sabbath day, the people began to steal out of church to learn of his adventures. In a short time the preachers, faced with empty pews, followed their congregations down to the quay.

Four years later, in December 1577, he started for the River Plate with five vessels under his command, the largest being the *Pelican* of 100 tons, which he renamed during his voyage the *Golden Hind*, his second ship, the *Elizabeth*, being but 80 tons. With these small craft he had made up his mind to sail to that sea he had seen from the hilltop and fill his holds with gold. It was an amazing voyage. Touching the South American coast, he sailed south and still farther south, along the eastern coast of Patagonia, until he saw an opening leading to the west. This was the Straits of Magellan, which lead by a most dangerous passage

through to the Pacific and save the mariner some of the fury of rounding Cape Horn ; in fact, the southernmost toe of South America, known as Tierra del Fuego, with the Horn at its point, is really a triangular island with sides about two hundred miles long. It took Drake sixteen days to navigate the straits. He had already burned two of his smaller craft as being useless ; now he rechristened the *Pelican* the *Golden Hind*. But instead of his troubles being at an end when he compassed the passage they were barely started. For fifty-two days he faced the most terrible series of gales he had ever experienced. He lost one ship with every soul aboard, but he did not lose heart. The captain of the *Elizabeth* would face no more, and set sail for home. Alone, though Drake was in a tiny ship, the unknown had no terrors for him. When the storms at last ceased, he sailed along the coast to the north, falling in with a ship or two and stripping them bare, finding in one of them precious stones to the value of well over £100,000, as well as over twenty tons of silver and nearly a hundredweight of solid gold.

Coming to Valparaiso, he went ashore and plundered the stores for his provisions ; then he went north again until he got to Callao in Peru. Once more his men shook out the sails and the *Golden Hind* breasted the seas until he fell in with another galleon at Cape San Francisco to the north of Ecuador, grappling with another and plundering her a few days later, sailing the sea of his dreams, and still farther north until he came to the passage, which he named the Golden Gate, that now leads to the harbour of San Francisco.

Despite his courage, he did not wish to face another sequence of storms such as had assailed him after passing the Straits of Magellan ; he would have tried for the North-West Passage from the east, but his men demurred, so he determined to cross the Pacific and sail westward until he found his way back to England. Only one man had hitherto succeeded in sailing round the world. That was the Portuguese Del Cano, who set out under

Magellan with five ships and two hundred and thirty-seven men in September 1519, on the famous voyage during which Magellan took twenty-two days to find his way through the Straits of Magellan—named after himself—and came out into a new ocean which was so calm that he called it the PACIFIC—the same ocean where Drake was assailed by storms for fifty-two days. It was three years before Del Cano returned with but seventeen men in one sorely battered ship.

Drake set his prow to the westward, and the *Golden Hind* sailed on for week after week, with never a sight of land. The monotony was dreadful, but on the sixty-eighth day they sighted some islands, the Moluccas, where they lay up for three weeks. Sailing off again, they dropped anchor on the coast of Java to take in water and attend to their other needs. Round the Cape of Good Hope the *Golden Hind* went ; skirting the coast of West Africa, she crossed the Bay of Biscay and came back at last to Plymouth on September 26, 1580, with treasure worth nearly two millions in her hold.

The Spaniards clamoured for his blood. He had sacked ships and cities and put people to the sword in the most piratical way. But instead of hanging him, as he richly deserved for the crimes he had committed, those crimes were on so stupendous a scale that the usual diplomatic excuses were found for him. He had, they said, but retaliated for the assaults committed by the Spaniards against the English, which was perfectly true, so Queen Elizabeth dined with the pirate on the *Golden Hind*, and, commanding him to kneel, touched him lightly on the shoulder with a sword and made him Sir Francis Drake. At the same time, Elizabeth saw that the greater part of the treasure he had filched from the Spaniards went to swell the coffers of England. She was a far-seeing Queen, who knew that the State can always do with money.

Much as we may condemn Drake and his piracies in these days, in his own day he was no better and no worse than many others. And the fact remains that

his voyage was a marvellous feat of seamanship—a feat of which Britain may always be proud.

He became the Mayor of Plymouth, and a Member of Parliament, but the account of his legitimate warfare as Vice-Admiral of the British Fleet when he helped to smash the Spanish Armada has no place just here. Our bold bad pirate whom all Englishmen love died of dysentery aboard his ship while leading another expedition against the Spaniards in 1596.

Half a century was to pass before Britain produced another man of such breed as Drake, and he, strange to say, was the son of a Somersetshire farmer. Educated at Yeovil Grammar School, William Dampier, whose father was already dead, lost his mother at the age of sixteen and went adventuring about the world. Apparently the sea attracted him, for in a year or two he joined the Navy to fight the Dutch, retiring wounded from the service.

Unable to rest, he was off again to the West Indies, and wandered thence to Yucatan on the borders of Mexico, where he spent his energies in a lumber camp, cutting down the giants of the forest and learning to wield an axe like an expert woodsman. Two years in the torrid atmosphere with the eternal zooming of insects, and he returned to marry, but not to settle down, for after a time he took ship again to the Indies and became an out-and-out pirate with other men as bad as he. Landing on the Isthmus of Panama, they attacked towns, murdered those who opposed them, and took what plunder they could. But sometimes they found the opposition too strong and had to retreat, leaving their dead behind.

Dissatisfied with his companions, Dampier and two or three others parted company from them, after bitter quarrels. They changed from ship to ship, eventually seizing a big ship of thirty-six guns, with which they raided the whole western coast of South America from Mexico to Chile, looting whatever was worth taking, leaving sacked cities and ships behind them.

Then they breasted out into the Pacific as Drake had done, sailing so far to the west that they touched the China coast, after which they sped south, with foodstuffs growing so scarce that the majority of the crew frankly decided to become cannibals, marking down their captain, a fine fat man, as the first to go into the stew-pot, and listing the other members of the company according to the meat they had on their bones; nor did they omit to include Dampier.

Luckily for the victims, land was sighted before the last morsels of food were eaten, and the crew avoided the crime of cannibalism. They were, however, as big a set of cut-throats as could be gathered together, and they had no compunction in casting Captain Swan ashore with some of the crew. Dampier, with three of the companions who had followed him so long, were the next to be marked down and cast away on Nicobar Islands, practically a thousand miles from Ceylon, lost in the middle of the Indian Ocean, with little more prospect of getting away than they had of flying.

It was nothing to the other villains whether Dampier lived or died: a life more or less was of no account, so long as their own skins remained intact. Life, however, was far too exciting for Dampier to give it up easily, and taking charge of his companions he managed eventually to obtain a native canoe, a frail thing which it seemed must be overwhelmed by the first wave that came along. In that little craft they set out boldly upon the Indian Ocean.

But for Dampier's wonderful seamanship and sense of direction they must soon have perished, for they might easily have gone too far to the south and so missed the land at which Dampier aimed. As it was, after suffering furious storms through which it seemed impossible that they could live, baling the canoe for their lives, being in danger of death every moment they were afloat, they made the coast of Sumatra. But it was a long and weary journey Dampier had to go before he made his way back to England.

Now the educated side of the pirate became dominant, and he wrote his *Voyage Round the World*, which was the best seller of his time, a book which throws into high relief the curious mixture of the man : pirate, murderer, philosopher, navigator, student—all were mixed up in the person of Dampier. Published in 1697, this book was very popular, so he sat down and wrote another, which he named *A Discourse of Winds*, which was published in 1699. Attracting the attention of the authorities, he was given command of a ship to explore the seas where he had suffered such adventures, and he carried out most valuable explorations of the Australian coasts.

He lost his ship and was marooned with his crew on an island for months before being taken off. When he went back to Australia he mapped nearly a thousand miles of the coast. He sacked cities, stacked his plunder in a Peruvian church, and went to sleep on it. But a dreadful stench assailed them, and within a couple of days nearly 200 of the crew were down with plague : the victims of plague had been buried just under where they slept ! Dr. Dover, who was as big a villain as Dampier, saved nearly all of them : his famous Dover's powder is still sold by the chemists to-day.

Once Dampier was court-martialled for cruelty; on another voyage he marooned Alexander Selkirk, who commanded his second ship, on Juan Fernandez Island, and forgot all about him until, over four years later, he wondered if he was still alive, and put in with Dr. Dover to find out. Selkirk was still alive, and Defoe founded *Robinson Crusoe* on his adventures.

In 1711 Dr. Dover and Dampier arrived back in England, with their holds full of gold and silver and jewels worth nearly a quarter of a million. Here was a fortune which the Somerset man was destined never to touch, for the authorities took charge of it, and he died in 1715, four years before the plunder was shared out. A picturesque villain, who was in continual danger of losing his life from all sorts of perils, he yet died peace-

fully ashore. While his infamies were numerous, he added not a little to the glory of England.

Son of a Yorkshire farm labourer, the self-taught draper's apprentice, James Cook, was quite a different type of man. Selling linen and tape and pins appealed to him so little that he took the first opportunity he could find of going to sea. By the time he was twenty-four he was familiar with the British coast, and two or three years later, when the press-gang had its eye on him, he voluntarily joined the Navy to fight against the French in Quebec. Here he distinguished himself by his survey of the St. Lawrence in the face of the enemy, thus finding favour with the authorities as well as with Sir Hugh Palliser, his commander. And whenever Cook had a spare moment he pored over his books on mathematics and astronomy, keen to learn and to better his position.

Thanks to the influence of Sir Hugh, he soon gained a ship and was told off to map the coast of Newfoundland, which he did. He did more than this—something which, quite outside his duty, eventually led to Australia being annexed to the British Empire. At first sight there is no possible connection between astronomy and Australia—they are as widely separated as is the sun from the earth—yet in the end a love of astronomy led to the Union Jack flying over the island continent. It happened that while Cook was charting the Newfoundland coast, there was an eclipse of the sun, which he observed with the most minute care, writing an account for the Royal Society. Cook's enthusiasm and keenness impelled him to this action, and it was this very report, considered in conjunction with his really fine charts and surveys, which led the Admiralty to appoint him, in 1768, to take out a ship to Tahiti to observe the transit of Venus in 1769.

This astronomical work he carried through thoroughly, and then made south to see if he could find any new lands. Round New Zealand he went, making invaluable charts of the land. Coming to the eastern coast of

Australia, he sailed along it to the north, landing at Botany Bay, where the fine trees and wide variety of plants were so impressive that he took possession of it in the name of Britain. Where Dampier on the northern coasts unluckily found only desolation, Cook struck the continent on its smiling side, which gave promise of a rich land that was worth possessing. His judgment has proved to be accurate. Incidentally, it is not usually known that Britain only prevented Australia from becoming French by the narrow margin of forty-eight hours—two days after the British convoy under Captain Phillips arrived, with eleven hundred souls to settle formally on the land and colonize it, the French arrived to do the same thing towards the end of January 1788. For two centuries Spain and Portugal had roved those seas, so intent on gold that they missed this greater prize of an island continent, which the tall, self-taught son of a Yorkshire peasant, one of the kindliest men alive, presented to the British Empire.

Wherever Cook landed, he sought to be friendly with the natives, making them presents and paying them for all he received. He would not tolerate brutality on the part of his crew. If the natives were hostile to him, he withdrew and found some who were more friendly. Sometimes, of course, he was obliged to teach the natives that they must respect the white man, but he punished them as little and as seldom as he could.

He mapped more than 2000 miles of the Australian coast; on his various expeditions he discovered the New Hebrides, New Caledonia, the Sandwich Islands, and others; he sailed farther south than any other man before him, and, being stopped by the ice, completely navigated the world in the southern hemisphere; where previously were unknown seas and mythical continents, he placed islands and lands in their proper positions on the map. Unhappily this kindly explorer, who was such a contrast to the bloodthirsty pirates who had gone before, was doomed to be murdered by the natives

of the beautiful island of Hawaii, which he had previously discovered. Owing to a boat being stolen by the natives, Cook was spurred to seize the king as hostage until the craft was returned. But the natives, alarmed for the safety of their monarch, attacked Cook and killed him on the beach, just as he was retreating to his boat. The tragedy occurred in 1779, when he was but little over fifty years old.

Young as he was when he died, he spent a full and happy life, and while other people were proud of his discoveries and the new lands he charted, that which gave him the greatest satisfaction was a thing few could guess. In those days scurvy was the dread of all sailors ; it often wiped out whole crews. Captain Cook, determining that the disease was due to an absence of green vegetables and fruit, saw that there was a sufficiency aboard, and that these vital stores were replenished at every point where they touched. And the thing which made him happy with the pride of achievement was the fact that in a voyage lasting three years he lost only one man—through an accident ! There was not a case of scurvy aboard during the whole time, so this brave seaman discovered how to abolish one of the most dreaded scourges of the sea, and in consequence was awarded the Copley Gold Medal by the Royal Society.

The exploration of the interior of Australia, the crossing of it from south to north and from east to west, has not been accomplished easily, and the adventures of the gallant men who have opened up the continent in themselves make a thrilling book. One of the saddest stories is that of Burke and Wills who, blazing a trail from south to north, a journey that had been accomplished once previously, met such terrible weather on the return journey that for miles they and their camels staggered along in thick mud which made travelling exceedingly difficult. When one of the four companions died, the others were so weak that they spent a day in scooping out a shallow grave for him, and while they

were engaged on that merciful task they were really digging graves for themselves.

Weak and exhausted, with but little food, they staggered to the rendezvous where they had told the other members of the party to wait for them so long as their rations would last. They found the camp deserted. Their comrades had departed a few hours previously. In his dilemma, Burke sought a new route back to civilization. For a week or two the survivors floundered about, hopelessly lost, now and again coming across a few natives, from whom they obtained the merest driblets of food. They struggled to retrace their steps to Cooper's Creek, and about two months after that fatal day when they had arrived there too late, poor Wills, who might have led the expedition to safety had he been the leader, collapsed and died. Burke himself did not last much longer, and King, dying on his feet, wandered round until he accidentally stumbled on a cache of native food. It saved his life, and the blacks, coming up, were fortunately friendly and took care of him until he was located and rescued. It was a tragic ending to a fine feat.

David Livingstone is another of the great explorers who are the salt of the earth. No sense of gain animated him, but the clean spirit of an honourable and upright Christian who was anxious to help humanity to better things. Born of poor parents near Glasgow in 1813, he spent his early years fighting tooth and nail for the education which he craved. Slaving as a boy in the cotton mill as a piecer—one who ties together the broken threads—he lightened the labour by teaching himself Latin, and years afterwards he was spending part of his time spinning cotton in order to gain a bare livelihood, while the other part of his time was spent in Glasgow University seeking the education that would fit him to go abroad as a medical missionary.

Strength of mind and will-power help such men to accomplish their desires. Not without reason was Africa called Darkest Africa, for the interior was a veritable

jungle of mystery and ignorance. Savage as the natives were, they were nature's gentlemen compared with the Arabs and Portuguese who enslaved them and treated them much worse than they would treat domestic cattle. With the zeal of the missionary flaming in his soul, Livingstone determined to do his best for the poor savages, to teach them the rudiments of trade as well as Christianity, to give them the semblance of organization. He lost himself among them, struggled with their dialects until he had mastered them and could teach; he succoured them when they were sick and ill, and his medical prowess soon won him favour among them.

He was indeed a noble man: they realized it and looked up to him. This was a white man they could trust, who would do them no injustice. Unlike those other whites whom they had learned to fear, he would not seize them and carry them off, nor would he treat them brutally. His bravery was obvious to them. A white man who walked without fear where death always lurked they could and did appreciate at his true worth. Probably he could have made many fortunes during his wanderings, but he would no more think of taking advantage of the natives than he would think of robbing his neighbour's hen-roost. He was, in fact, a real white man. And he devoted himself to finding routes through the jungle, routes where trade would follow him and civilization gradually filter through. If the worst has followed him instead of the best, that, alas! is not Livingstone's fault, but the fault of the men who came after.

That first great trek, which took him from Cape Town, right up through Bechuanaland, and across the dread Kalahari desert, brought him to the coast at Loanda, in Portuguese West Africa, just a walking skeleton. After a little rest to gather together his strength, he set out to find a way across the continent from west to east, a feat that had never been accomplished by any white man. He had many adventures before he arrived in Portuguese East Africa at Quilimane

in May 1856, less than two years after he had started out from the western coast. He found the source of the great Zambesi, and he was going through the woods one day when the thunder of water far off came to his ears, and a magical rainbow always seemed to be hovering in the air. Pushing on, he came at last to that wonder of wonders, the Victoria Falls. It was to him, the first European who had ever gazed upon it, an astounding sight. The river above was well over half a mile wide, studded with rocks that had withstood the swift-flowing waters for ages, and it slid over the ledge into a 400-feet deep cleft that was only forty or fifty yards wide. The sun shining through the eternal spray caused the rainbow. Think of the electrical power going to waste, of the hardness of the basalt which has withstood and imprisoned that raging cataract through the æons of time since the basalt first split !

He found Lake Nyassa, as well as the main source of the Congo in Lake Bangweolo, which Stanley afterwards verified, but to his infinite grief he lost his dear wife. He was so deeply affected that he would have been content to die, and while his grief was still on him he wrote of his own death : " I have often wished that it might be in some far-off still forest."

But his end was not yet. Once more he went to his beloved Africa and vanished in the wilds. None knew whither he had gone. There was no news. The natives whom he had striven to teach filched the stores on which his life depended. But his own servants, those who knew him and had followed him wherever he cared to lead, were the loyalest set of men—white, black, yellow, or red—who ever lived.

So concerned grew the public about his safety that an expedition under H. M. Stanley was sent to find him. The story of how Stanley, coming on him in the wilds, raised his hat and said : " Dr. Livingstone, I presume ! " is known the world over, and the hat itself, along with Livingstone's cap, may be seen among the relics of the Royal Geographical Society to-day.

Stanley journeyed to England, his mission accomplished, to win the plaudits of the multitude, a fortune from his lectures, and eventually a knighthood from the State. Before that came to pass he led an expedition fitted out by the *Daily Telegraph* and *New York Herald* to explore the river Congo, during which he had the most extraordinary adventures. In vain he besought Britain to annex the Congo, so he went out again as the emissary of King Leopold to take possession of that territory, which is now the Congo Free State, for Belgium. From the time he left a Welsh workhouse as a boy, till he became a Member of Parliament and was knighted by Queen Victoria, Stanley's life was one long series of amazing experiences and escapes.

After Stanley had replenished his stores and succoured him, Livingstone, who had spent his life labouring for the natives of Africa, struggled on exploring for another year. Then, on the morning of May 4, 1873, his native servants found this unselfish and brave man dead, kneeling beside his crude bed in an attitude of prayer.

Thus he wrote to the world: "All I can say in my solitude is, may heaven's rich blessing come down on everyone—American, English, Turk—who will help to heal this open sore of the world."

Only in death was Livingstone's greatness properly understood, for his native servants were so devoted to him that, quite unprompted, they buried his heart beneath a forest tree, and carried the embalmed body of their dead friend and master across hundreds of miles of almost impassable country down to the coast. No man, unless he were truly great, could win such a deep affection from those who served him, and the remains of a nobler man were never interred in Westminster Abbey among our national heroes.

While Livingstone gave a good deal of his attention to puzzling over the mysterious source of the Nile, it was left to Captain John Speke, a soldier bred in Somerset, definitely to locate the Nile flowing out of the northern

end of Lake Victoria Nyanza at Ripon Falls. It was merely a native rumour which led Speke in 1858 to discover the great inland sea of Victoria Nyanza, and he felt sure that the lake was the source of the Nile. But Burton, with whom he was exploring, totally disagreed with him, so the two arrived in England at loggerheads.

Speke, however, did not rest at home long, and three years afterwards he was back at the place where he had heard the first rumour of the existence of the great lake he had discovered, taking with him Captain Grant, who also did splendid work. Speke, exploring the lake while Grant explored overland, at length came to the Ripon Falls, and knew that the stream flowing thence was the sacred Nile, the river on which the very life of Egypt depended, the river which had seen some of the earliest civilizations bloom and decay. Even when he returned to England and announced his discovery, many scientific men refused to believe that the Nile sprang from the very heart of Africa. But in later years it was proved that the Englishman had indeed discovered the source of one of the longest and oldest rivers in the world.

This great continent, so fertile, so rich in minerals, so afflicted with the terrible insect-borne diseases of the tropics, may be destined to play as important a part in the civilization of the future as it has undoubtedly played in the past. It is indeed a land of promise which spread a net of fascination for that greatest of all Empire builders, Cecil Rhodes. Maligned as he was in his own day, lacking recognition in our own time, he may be accorded by the British Empire of to-morrow the meed of praise that is his due for his far-sighted endeavours to carry the British Flag from South Africa to the northernmost point on the Mediterranean.

It seems only yesterday that the newspapers were announcing that Mr. Grogan and Mr. Sharp had succeeded in their perilous enterprise of journeying from south to north, yet I know it is over thirty years ago that they

won this honour for Britain. Cecil Rhodes himself sums up the feat very neatly in his introduction to Grogan's book, *From the Cape to Cairo*: "I must say I envy you, for you have done that which has been for centuries the ambition of every explorer, namely, to walk through Africa from south to north. The amusement of the whole thing is that a youth from Cambridge during his vacation should have succeeded in doing that which the ponderous explorers of the world have failed to accomplish. There is a distinct humour in the whole thing. It makes me the more certain that we shall complete the telegraph and railway, for surely I am not going to be beaten by the legs of a Cambridge undergraduate."

Certainly it has its amusing side, but only Grogan and Sharp know what they endured during those last terrible weeks, the sight of the eternal beastly crocodiles lying on the mud, of the birds of prey, ghouls of the air, hovering overhead waiting and hoping to pick their bones. A comical incident that is hard to beat was when Grogan one morning was having his bath while four giraffes poked their heads over a bush and evinced great curiosity concerning the movements of the strange creature splashing in the water; that night two lions came strolling about the camp.

When they broke camp next day they reckoned on a four days' struggle before they could get into touch with civilization. To Grogan's delight he saw a pole which proved to be the mast of a boat, and learned that Captain Dunn, R.A.M.C., was out shooting. "I could scarcely believe that it was all over, that my troubles were ended! Those four days, that I imagined still remained, had been a nightmare to me. All my men were sick; the majority of them had to be pushed along at the point of the spear, to prevent them from lying down and giving up the struggle. There were no more hippo and very little game: all our grain had been exhausted, and but two pipefuls of sour tobacco remained. And then, at a sudden bend of the river, all

this nightmare was dispelled! It was over! From being so long without vegetables, my hands had begun to turn black, and the continual anxiety of the last month, day and night, had told its tale on my nerves."

Grogan's meeting with Dunn serves to rank with that of Livingstone and Stanley. "How do you do?" said Dunn.

"Oh, very fit, thanks; how are you? Had any sport?" replied Grogan.

"Oh, pretty fair, but there's nothing much here. Have a drink? You must be hungry; I'll hurry on lunch. Had any shooting? See any elephant?"

Not until they had washed, eaten their lunch, and held forth about the war in the Soudan did Dunn inquire where Grogan had come from!

Said the servant of Captain Hayes-Sadler, the Governor of Fashoda, when he asked whence Grogan came and learned that he was travelling for the pleasure of seeing the country: "Ah! You are a strange people, you English Effendis!"

Perhaps we are, but it is given to some, like Grogan and Sharp, to do great things in a quiet way.

Let me quote once more, this time from Grogan's Preface to his book: "While we sleep, broad tracks have been cut for us by those we revile. Far and wide our outposts are awake, beckoning to the great army to sweep along the tracks. Let each man with means and muscle for the fray go forth at least to see what Empire is. Clive, Hastings, Rhodes, a thousand lesser men whose tombs are known only to the forest breeze, have left us legacies of which we barely dream. Millions of miles of timber, metals, coal, lie waiting for the breath of life, 'pegged out' for Britain's sons. In these our destiny lies. We live but once: let us be able, when the last summons comes, to say with the greatest of us all, 'Tread me down. Pass on. I have done my work!'"

This is the spirit of England, the same spirit which sent our seamen hunting, hunting for the North-West Passage in the ice-locked north, a passage which they

felt in their bones must exist, if only they could find it. John Davis, seeking it in 1585, found Davis Strait, and saw Greenland again after it had been forgotten for over a century, but the passage leading round to Alaska and China baffled him. So sure was he, however, that he went to seek it from the Chinese side, and found death at the hands of Japanese pirates instead. Then a real Cockney, William Baffin, who was born in the days of Drake, penetrated Davis Strait and discovered Baffin Bay in 1616—it was the way Peary took to the North Pole—but Baffin's discovery was regarded as idle chatter, and the North-West Passage was yet to find. Baffin, a poor London boy, somehow managed to educate himself until he became a skilful navigator. He found in Lancaster Sound the actual entrance to the passage, but the ways were far too tortuous and long for him to follow, even if he had known where the channel led.

So men went on questing in icy seas in little wooden craft that seemed far too small and frail to withstand the perils of those latitudes, but the North-West Passage eluded them. In our own time the discovery of the North-West Passage is being freely accredited to Roald Amundsen, the brilliant Norwegian explorer who discovered the South Pole and who so gallantly gave his life in an effort to find and rescue the lost crew of General Nobile's airship in the Italian Polar Expedition. Amundsen's wonderful voyage in a little sealing-boat, the *Gjoa*, of forty-six tons, fitted with a petrol engine and manned by half a dozen men, will never be excelled. It is an epic of adventure. How they nearly lost their boat by fire, how they remained happy and well in that icy wilderness for three years, how they were able to succour another craft from their own stores of flour, their many other adventures in that amazing journey, have no place here, except that I may pay a tribute to the courage and leadership of the man who, on September 1, 1906, came into the harbour at Nome in Alaska after making the first voyage from end to end of the North-West Passage.

Without seeking in any way to belittle that magnificent feat, on the facts, the honour for discovering the North-West Passage must go to Sir John Franklin. In the first place, it must be borne in mind that no man living was more familiar with that northern coast than he. For years he had served the finest of apprenticeships by charting the coast. From the Mackenzie River back to the Colville River he had mapped it thoroughly on an expedition that lasted over three years. On a previous expedition he had explored the whole of the Coppermine River, and all along the coast-line of Coronation Gulf to a point some six hundred miles eastward. These were the very foundations of the North-West Passage, and he laid them truly and well, but his commissions on those occasions did not carry with them the instructions to attempt to find the passage. They were merely preliminary expeditions, that were very fruitful of results, and they placed him in a better position than any other man to solve the mystery which had mocked mariners for so long.

When, in 1845, Sir John Franklin left England with the *Erebus* and *Terror*, it was with the definite instruction to attempt the North-West Passage. He was then a man of fifty-nine, an old man to undergo the hardships inseparable from such an expedition, but he was strong and healthy, and he possessed in his brain a greater knowledge of that northern coast than all the rest of the navigators put together. Had he not put thousands of miles of those northern lands definitely on the map, where before were just blank spaces ?

That intuition, that sense of direction without which a man is useless for exploration, told him that if he could make a passage from the east to the neighbourhood of the Fish River, the way lay open before him. Thenceforward he was back in his old haunts, and the coast was known to him personally for hundreds and hundreds of miles, besides which the route round from the Alaskan side through the Behring Straits was also known. As a matter of plain fact, so sure was he, and so sure were

the British Admiralty, that he was given definite instructions to follow that route.

So he made his way through Lancaster Sound, which Baffin had found, and vanished, nor was he ever seen alive again. Disaster, complete, overtook the whole expedition ; not a single man escaped, and there were dozens of expeditions fitted out to find Franklin before M'Clintock eventually solved the mystery of what happened. It was a sad, a terrible story : a long fight against adverse weather, and an attempt by the survivors to reach one of the Hudson Bay Company's depots overland, with a trail of starvation and death.

Franklin, fortunately, died before the worst befell ; he was spared the suffering of his followers. For two years the ships were locked in the ice ; Franklin was helpless. In a cairn of stones heaped up on Point Victory were found some records which stated that the *Erebus* and *Terror* were deserted on April 22, 1848, five leagues to the north, north-west of that point, and that they had been imprisoned in the ice slowly moving along since September 12, 1846. Franklin himself died on June 11, 1847, and of the crew of 134 which started out, 106 had landed, thus already 28 men had passed away. Now in September 1930, after the lapse of eighty years, Major Burwash of the Canadian Geological Survey has found further relics of the expedition.

The worst disaster in the whole history of Arctic exploration, it has but one redeeming feature. From the position in which Franklin's ship was found on the shores of King William's Land, the way was already known from the west. Franklin himself had charted the greater part of it, and men had penetrated from the west to a point eastward of that which Franklin had already managed to pass in his journey from the east. Franklin, in finding his way from the east to the point at which he arrived, definitely discovered the North-West Passage. But although Franklin had given his life to find the way, and had died when he had accomplished the task, it was sixty years before any man

succeeded in traversing the North-West Passage from end to end. That was the high accomplishment of Amundsen.

Of the dozens of brave men who have explored rivers and mountains these pages may not even hint, but before dealing with the Antarctic it is a pleasure to touch on the British expeditions which have attempted to climb Mount Everest—the highest mountain in the world with an altitude of 29,180 feet, unless the reports be true that another unknown mountain of the gigantic Himalaya Range overtops it. Everest still rears its pyramidal peak unconquered by the foot of man, but if the British expeditions have failed they are some of the most glorious failures in human endeavour. These were not expeditions that set out to make money ; their sole aim was to climb to the summit of the world's highest mountain in order to prove that the Britons of to-day are no less courageous and capable of endurance than were our forbears, that the race is not decadent.

Those who know what the members of the expedition endured, the terrible séracs they had to pass, are filled with pride at their accomplishment. It is sad that they did not succeed, and that Mallory and Irvine, who were selected to essay the final few hundred feet, should lose their lives when their goal was in sight. Last seen when a little short of the summit, they just disappeared and vanished from life. It was what one would expect from such gallant men. They had made up their minds to conquer—and they died, gloriously, for England, proving that the race still breeds good men and true.

I have vivid recollections of a conversation I had with Mr. T. H. Somervell after the second expedition in 1922, when Somervell, Norton, and Mallory managed to reach a height of 26,985 feet without wearing any oxygen apparatus at all. It was at that time the highest point on the earth's surface ever climbed by the foot of man unaided, and it was achieved by young Englishmen. According to tests carried out in the United States, the air is so rare at this altitude that human life ought to expire, yet the mountaineers lived and struggled

up and down while subject to this fearfully low atmospheric pressure. But all the time the body, of course, is fighting for enough oxygen to sustain life, and Somervell told me that he was breathing or panting sixteen times for every step he took. He was like a runner utterly spent after a race. And he recalled that although he managed to take a photograph pointing towards the summit when he reached the spot where they could go no farther, he has not the slightest recollection of doing so. He must have taken it subconsciously, and they must have gone on climbing in a semi-dreamlike state. Although beaten back, his spirit was not conquered, and he mentioned quietly that he thought it quite possible to attain the summit without oxygen, if things went favourably.

A surgeon, with no knowledge of music, he invented his own system of recording the Tibetan songs that were sung to them, a system that he explained to me strolling along towards Oxford Circus on a cold, dry night. I asked him about the avalanche that had killed some of the porters.

"Oh yes," said he. "I suddenly saw a crack appear in the snow and a layer about half the size of Oxford Circus began to slide. It knocked us down and buried us and carried us away for a short distance, but we got out safely. The porters had been swept over the edge, and by the time we managed to climb down to them and dig them out we found seven were dead."

It all seemed so incongruous, this young surgeon who had gone to within a few feet of the highest altitude attained up till then by the foot of climber—Captain G. Bruce and Captain Finch managed to get to 27,235 feet by using oxygen—standing there talking quietly to me in the streets of London. Modest and unassuming, his one hope then was that he might have another try to get to the top of Everest.

That wish was fulfilled, and on June 3, 1924, Somervell and Norton made a camp at 26,800 feet—higher than ever before—and from this camp the two plucky

By permission, The Mount Everest Committee

COLONEL NORTON CLIMBING AT NEARLY 27000 FEET DIRECTLY TOWARDS THE SUMMIT OF EVEREST, WHICH MAY BE SEEN IMMEDIATELY AHEAD. THIS PHOTOGRAPH IS ONE OF THE HIGHEST PHOTOGRAPHS EVER TAKEN ON EARTH, AND MR. SOMERVELL TOLD THE AUTHOR THAT HE DID NOT REMEMBER TAKING IT.

climbers fought upward without oxygen to 28,126 feet—less than a thousand feet from the top ! Of their physical sufferings they made little. " Our pace was wretched," wrote Norton in that fine book, *Fighting for Everest.* " My ambition was to do twenty consecutive paces uphill without a pause to rest and pant, elbow on bent knee ; yet I never remember achieving it—thirteen was nearer the mark."

Norton suffered from defective vision. Somervell was so terribly hampered by an affection of the throat, caused by the low atmospheric pressure of that high altitude, that at about 28,026 feet he begged Norton to go on alone. Norton accordingly struggled on, but there was not time for him to get to the top and back to camp, so at 28,126 feet he turned back. " In an hour I had gained but little—probably under 100 feet in height, and in distance perhaps 300 yards—on the position where we had separated," he wrote. Only their unbeatable spirits brought them safely, but utterly exhausted, back to camp. That climb down was a nightmare to both. Once Norton missed Somervell, and looked back to find him in a paroxysm of coughing—" he was probably only saved by coughing up the obstructing matter, along with a lot of blood," comments Norton, who in camp that night went completely blind, and did not see again for three days.

Then Mallory and Irvine went forth, but whether they reached the summit and died on the way down, or whether they failed to reach the top, is a question that may for ever remain unanswered. Odell, who last saw them moving like black specks against the snow when they were some 500 yards from the summit and had about 800 feet to climb, is inclined to think that they succeeded and were lost coming down, that they were overtaken by the darkness and were killed by the cold. Who knows ? This much is sure : whether they succeeded or failed, they died bravely, and, like the rest of the climbers, they risked their lives not for personal gain, but for the glory of their country.

It was Robert Peary who planted the American flag at the North Pole, but Ross, at any rate, located the North magnetic pole for Britain, just as members of the Shackleton expedition located the South magnetic pole for this country in 1908. Shackleton himself in his dash for the South Pole met with terrible conditions, with crevasses that made progress at times almost impossible. A terrible blizzard kept the explorers cowering in their sleeping-bags in the frail canvas tents for nearly three days, and Shackleton was obliged to turn back when but ninety-seven miles from the Pole.

The experiences of Sir Douglas Mawson in the southern polar regions are among the most amazing of all. Adelie Land, which he calls "an accursed country," is a land of eternal blizzards. The gales used to whip up the snow from the snowfields far inland and whirl it past the hut in a continual stream out to sea for months on end, blotting out all sight of the sun. The velocities attained by the wind seem almost unbelievable. In one season for the month of March it averaged 49 miles an hour; then April beat this record with an average of 51½ miles an hour; while May made the April record seem quite tame, for night and day throughout the month the blizzard blew so furiously that the average worked out at over 61½ miles an hour.

For one whole day the hurricane roared at 90 miles an hour, while there were awful gusts that shrieked at 150 and even up to 200 miles an hour. No wonder the explorers were afraid sometimes that the whole hut would be picked up and whipped out to sea. This would undoubtedly have been its fate had it not been buried in the snow, the depth of which forced the explorers to dig a series of ice tunnels from the main hut to the outbuildings, tunnels which they called the catacombs. As the gales shrieked overhead, they walked safely under the snow.

The wind was so strong that the explorers literally used to lean on it. Often a gust picked them up and blew them down like ninepins, and they had a lot to

learn before they could manage to get about in the winds at all. Many found the safest plan was to crawl! Describing what it was like in his book, *The Home of the Blizzard*, Sir Douglas wrote: "A plunge into the writhing storm-whirl stamps upon the senses an indelible and awful impression seldom equalled in the whole gamut of natural experience. The world a void, grisly, fierce, and appalling. We stumble and struggle through the Stygian gloom; the merciless blast—an incubus of vengeance—stabs, buffets, and freezes; the stinging drift blinds and chokes."

That a man who survived such a terrible trip across King George the Fifth Land could ever return to those dreadful wastes, passes the human understanding. Mawson one day shot across a crevasse concealed by a bridge of snow. Mertz followed and raced down the slope after him, but when they looked back for their companion, Ninnes, he was not to be seen. He had plunged through the snow-bridge into the crevasse with his dog-team and a fortnight's supply of food for the three of them, a crevasse so deep that they could not plumb the bottom. Their calls elicited no answering cry.

Mawson and Mertz sadly turned away. One by one the dogs passed out; then Mertz, who had been weakening for days, died in his sleeping-bag. Alone, Mawson struggled on, making a few miles a day; his frost-bitten soles parted company with his feet, and he had to bind them back in their place, after smearing lanoline between them and the new skin that was forming.

More than once his sledge saved him from a crevasse. Hanging by the harness, he managed to struggle out. Then his weakness compelled him to make a rope-ladder, so that if he fell he would be able to climb back again. He had but two pounds of food left when he came to a big snow cairn erected by a search-party that very morning, and on top was the food which saved his life.

Fitting a sail to his sledge, he let the wind drive him down the slope towards safety. Coming at last to a wonderful ice cavern, known as Aladdin's Cave, which

was only five miles from the hut, he dropped down into it. No one was there, but he found some fruit, and here the gale imprisoned him for a week before he could venture out, and the members of the hut saw the sole survivor of the exploring party staggering towards them. Was ever a more gallant knight than Sir Douglas Mawson, who saddled himself with debt to explore the Antarctic wastes ?

If you are visiting the British Museum, I would suggest that you turn to the right at the main entrance, pass through the first room with its unique illuminated manuscripts, and make your way to a case on the right in the next room. You will see there a little leather-bound book with a few words written in pencil. This little book to me is the Glory of Britain incarnate, worth all those other priceless manuscripts put together; it is the very soul of nobility and courage, the emblem of modern knighthood, the diary of Captain Robert Falcon Scott.

When Scott set out on that last fateful expedition, he knew that Amundsen was taking the ***Fram*** to the Antarctic, but assumed that the Norwegian was going to explore in the region of the Weddell Sea. The news that Amundsen had landed on the Barrier and was laying depots in an effort to reach the South Pole came as a complete surprise to Scott and to the other members of the party.

But Scott would not allow himself to be stampeded into doing anything that would endanger his companions. As he states in his letter in Stephen Gwynn's book, *Captain Scott* : " The proper, as well as the wiser, course for us is to proceed exactly as though this had not happened. To go forward and do our best for the honour of the country without fear or panic. There is no doubt that Amundsen's plan is a very serious menace to ours. He has a shorter distance to the Pole by 60 miles —I never thought he could have got so many dogs safely to the ice. His plan for running them seems excellent. But above and beyond all he can start his journey early in the season—an impossible condition with ponies."

Amundsen put his faith in dogs, and was justified.

By permission of the Scott Polar Research Institute, Cambridge:

A TRAGIC AND HISTORIC PHOTOGRAPH OF CAPTAIN SCOTT AND HIS PARTY AROUND AMUNDSEN'S TENT AT THE SOUTH POLE. SCOTT IS TO THE LEFT; CAPTAIN OATES, THAT "VERY GALLANT GENTLEMAN" WHO WALKED OUT INTO THE BLIZZARD TO SACRIFICE HIS LIFE AND GIVE THE OTHERS A CHANCE TO PULL THROUGH, IS NEXT; DR. WILSON IS BUSY MAKING A SKETCH OR NOTE; AND PETTY OFFICER EVANS IS TO THE RIGHT. THIS PHOTOGRAPH WAS TAKEN BY LIEUT. BOWERS, AND THE NEGATIVE WAS FOUND IN THE TENT WITH SCOTT AFTER HIS DEATH, ALONG WITH THAT LITTLE DIARY WHICH IS ONE OF THE UNDYING GLORIES OF THE WORLD.

Where the Norwegian found good going, the Englishman faced the most awful conditions. On the way up to the central plateau Scott lost four days on his schedule, but by dogged marching he made up the time. Imagine the feelings of the five Englishmen when, after all they had suffered, they found Amundsen's flag flying at the South Pole on January 17, 1912, and learned that their rival had beaten them by over a month! Then frostbite marked down Evans and delayed them on their return, until that terrible fall on his head led to the death of the sick man on February 17. There was still a chance of reaching safety, but the terrible weather mocked them, and the awful frost touched the feet and hands of Captain Oates. He fought onward uncomplainingly, suffering agonies in silence, but the physical pain was as nothing to his mental anguish. He knew that he hampered his companions and robbed them of their only chance, and on St. Patrick's day, March 17, he got out of his sleeping-bag. "I'm just going outside, and I may be some little time," he said.

"We knew that Oates was walking to his death," wrote Scott in that sacred little diary; "but, though we tried to dissuade him, we knew that it was the act of a brave man and an English gentleman."

"Had we neglected the sick," he wrote in one of his farewell letters, "we could have won through."

Eleven miles from safety was their tent pitched, with One Ton Depot and fuel and food so close. And then while the blizzard raged and made death certain, Scott wrote his last memorable words, and the others calmly lay until the final sleep overwhelmed them. With a temperature of 40 degrees below zero, he forced his pencil over the pages—tender letters to his mother, to his wife, to whom he wrote: "There is a piece of the Union Jack I put up at the South Pole in my private kit-bag, together with Amundsen's black flag and other trifles. Send a small piece of the Union Jack to the King, a small piece to Queen Alexandra, and keep the rest, a poor trophy for you——"

And this was his letter to ENGLAND :

" For four days we have been unable to leave the tent—the gale howling about us. We are weak, writing is difficult, but for my own sake I do not regret this journey, which has shown that Englishmen can endure hardships, help one another, and meet death with as great a fortitude as ever in the past. We took risks, we know we took them ; things have come out against us, and therefore we have no cause for complaint, but bow to the will of Providence, determined still to do our best to the last. But if we have been willing to give our lives to this enterprise, which is for the honour of our country, I appeal to our countrymen to see that those who depend on us are properly cared for.

" Had we lived, I should have had a tale to tell of the hardihood, endurance, and courage of my companions which would have stirred the heart of every Englishman. These rough notes and our dead bodies must tell the tale, but surely, surely a great and rich country like ours will see that those who are dependent on us are properly provided for. R. SCOTT."

They could have killed themselves with opium, but they would not. They lived cleanly, and they died nobly. Not for a moment did the thought of leaving a stricken comrade ever cross their minds. It was their unwritten rule to stick by each other to the end. " There is nothing I would not do for him ; he is just splendid," wrote Wilson of Scott in a letter to Lady Scott.

And those last few shaky words which the unconquered Soul compelled the dying hand to write, painfully, in that little leather diary : " For God's sake look after our people ! "

That is the Spirit of England, speaking from beyond the grave. Scott proved one thing by his death. It is not the winning nor losing that matters, but the courageous spirit in which the game is played.

CHAPTER XII

MUSIC, PAINT, AND PRINTING INK

MUSIC to millions to-day signifies no more than jazz, with the saxophones making their uncouth sounds over the wireless, and raucous voices with American accents telling us that they want to go somewhere or other. The trouble is, that they tell us too often and go too seldom, whereas if I were Mussolini I would see that they did go, directly after the first verse. Post-war youth, and age too, has been rather jazzled, if I may be permitted to coin a word; it has been jazzled by noise and rhythm, and directly it gets to its feet it goes off its head, or as soon as it steals to the tongue it slips out at the toes. Most jazz is, I fear, a nightmare of noise; occasionally there is a hint of melody, but always there is rhythm. And I admit that rhythm, as rhythm, can be rather fascinating. But it is not music, any more than the rolling drums of the Boy Scouts or Guards are music, yet their rhythm sets the feet tapping, which is what jazz does.

Jazz is an uncivilized lapse into barbarism, to the war dances of savages; the main rhythm of the tom-toms is overlaid and decorated with other rhythms by other instruments intended for finer things, and debased to this. But as it gives pleasure to a vast multitude, in so far it has its uses. No one will grudge the United States its meed of praise for this savage lapse. To the United States, therefore, we take off our hats for presenting us with Jazz—the Antithesis of Music.

Like measles, it is running its course, and when the last rash has broken out and dispersed and the last

negro drummer been sent back to Ohio, or his Kentucky home, music will always remain.

In music, real music, the Germans are dominant. Bach and Beethoven and Wagner are inspired geniuses such as no other race can match, nor all other races together equal, and it has always been a mystery to me how Bach with his enormous family and the corollary of domestic and financial difficulties managed to complete such a large body of work of such high quality as he left us to enjoy. Just as Bach influenced Beethoven, so the latter influenced Wagner. I see Beethoven, with his rugged face and massive brow, gifted by the gods above all others, yet doomed by them to drink the bitterest draught of all. That deafness should prevent the great creator of beauty from enjoying the beauty he created is surely one of Fate's sorriest jests, yet in his mind he must have heard those sounds he made captive on paper, and had he lived in our time Science would have given him ears to enjoy his glorious symphonies being burgeoned forth by the full orchestra. As for Wagner, the fairies must have given him all gifts at his cradle—except the ability to behave honourably towards women. To write the music for "The Ring" was a colossal feat for the human mind; to write the libretti, to conceive and design the settings and scenery, to produce them, it seems that no single human brain could encompass the whole. Yet the German, of his genius, accomplished them all.

There are many other men of other races whose works give me sheer delight, but I need not dwell on them here. With a reputation for being an unmusical race, the British certainly are not so musical as some of the continental peoples. Last year on the shores of the Mediterranean I was wakened one morning by a fine tenor voice singing an operatic song. Peeping out of the window, I saw a young black-haired navvy engaged in excavating a trench for some electric cables and singing for the sheer joy of being alive. I have heard other southern people singing snatches from the operas,

women sitting in soap boxes doing their washing in the running streams, men sweeping the streets, fellows cycling along the roads. They think nothing of it : it is as usual for them to express themselves in this manner as it is for Scots to sing " Auld Lang Syne " on New Year's night. It was in London, however, that I received my biggest surprise. Walking along a quiet road one sunny afternoon in spring, I heard the slow movement of the Mendelssohn violin concerto being whistled with all the verve of a finished artist. In a few moments a little errand boy, his elbows out of his sleeves, a patch on his knickers, came round the corner with a basket on his arm, whistling as naturally as a blackbird and nearly blowing out his front teeth. I was so amazed that I let him go by without stopping him—a lapse I have always regretted.

While Englishmen like Byrd and Bishop and Purcell wrote some very sweet and delightful songs in the early years, when music was beginning to develop, and Scotland and Ireland and Wales have also given the world some beautiful melodies, Britain has no body of work to compare with the German music. We have our minor men, like Sullivan, whose music is as English as a meadow in Maytime, but until our own period we have thrown up no musicians who can be termed really great.

But in Sir Edward Elgar we have a master who will compare with the greatest of any nations, a composer inspired by sheer native genius. Elgar's best work will not only live, but it has a healthy beauty which is not excelled by German or French or Russian music. I enjoyed the experience of listening to Kreisler playing the Elgar violin concerto for the first public performance ; and one afternoon, long years later, when I was taking tea with the famous violinist, I mentioned this work.

" I recall the rapture the first time I played the last movement," Kreisler said to me. " I was in the composer's study. Scattered all around on the floor were the sheets of manuscript where the composer had dropped them to dry as they came from his pen. We picked

them up between us, numbered them hurriedly, and I set them, still barely dry, upon the music stand, picked up my violin, and played. As I played I knew that he had given us a work that was great, full of inspired passages, and when I had finished I turned to him and, gripping his hands, thanked him for choosing me to interpret his work to the world. In Sir Edward Elgar, England possesses a great musician, a master who is eminently sane, whose best work makes for peace and happiness amid the misery and distractions of to-day. I am happy to count this unassuming genius, this kindly English gentleman, my friend."

A few hours after Kreisler entertained me at tea, he was due to play in Eastbourne, but he was unable to travel down by car, owing to his engagement with me. Perhaps it was as well, for on the road to the coast his car met with an accident, in which his accompanist was injured. But for that engagement with me, he himself would have been involved, and who knows but that the magic of Kreisler might perchance have been stilled. As it was, he travelled by train later, and only learned of the accident on his arrival.

Delius, the blind Yorkshire composer, who has spent the greater part of his time in France, has done some very fine work, but Elgar is the first giant of Music that Britain has produced, and the fact that he is still alive betokens that in this realm of art, where we have been content to occupy a minor position, we are breeding men who may help to play a similar part in developing the music of the world as Britons have played in developing the world's machines.

The builders of bygone times have left us a rich heritage in our glorious cathedrals, in the grandeur of Canterbury, the twilit beauty of Westminster Abbey, of Ely, of York, of Salisbury. But the great Sir Christopher Wren—inventor, scientist, astronomer, and architect—who designed and superintended the building of St. Paul's on the top of Ludgate Hill, is one of the architectural geniuses of all time. Other men may have

Donald McLeish

OF THE MANY FINE OLD BRITISH CATHEDRALS, NONE IS BETTER KNOWN THAN SIR CHRISTOPHER WREN'S MASTERPIECE OF ST. PAULS WHICH, PILING UP PICTURESQUELY ABOVE THE THAMES, HAS DOMINATED LONDON FOR OVER TWO CENTURIES

done as well, but none has done better. Masterpiece as is St. Peter's in Rome, it is a masterpiece of many hands, whereas St. Paul's is Wren's alone, from the cross on the dome to the shallow foundations in the London clay. And the way Wren took the weight of his great dome by distributing it over an inner cone of brickwork anchored with chains was sheer inspiration.

Calamitous as the Great Fire of London was to the people of those days, it brought two blessings in its train. Millions of plague-spreading rats were destroyed and the disease was thus arrested, and wide areas of human rabbit warrens were burned to the ground, as well as old St. Paul's Cathedral. While the authorities would not carry out Wren's plans for rebuilding the burned down area in the form of broad streets and fine squares—London would have been a nobler city to-day, if Wren had been given his way—he was allowed to rebuild the cathedral of his dreams, a task that occupied him for thirty-five years, from 1675 to 1710, but he lived to see it finished. For rebuilding St. Paul's and dozens of churches his recompense was only £300 a year! In Court, favourites come and go, intrigues are always going on, and the favourite of to-day is the outcast of to-morrow. Wren himself suffered these periods of eclipse, but St. Paul's remains the living monument to his genius. If it be thought that the art of old masters who scattered our beautiful cathedrals so lavishly through the land has been lost, then we only need to visit Liverpool to see its lovely cathedral slowly blooming to realize that we have builders and architects to-day as great as any of the ancients or moderns of any other land. Given the occasion, I firmly believe that somewhere some Briton will always be found to rise to it.

The exhibition of Italian pictures at the Royal Academy in London in the early weeks of 1930 sufficed to show a few of the masterpieces which Italian painters have produced for our delight, and the Italian nation which has sired such painters as Titian and Leonardo da Vinci and Raphael and Michael Angelo has reason to

pride itself on the work of its sons. That the cartoons of Raphael to be seen in the South Kensington Museum in London could have been tossed aside as lumber, seems hard to believe—it is the sort of thing that one could imagine would occur only in England.

Probably I shall be regarded as a Goth and Vandal when I remark that, wonderful as these Italian paintings are reputed to be, and valuable as they undoubtedly are, if I were given my choice there would not be many that I would care to place on my walls and live with every day. There was a portrait of a dark-eyed boy that would please me always, and a lovely portrait by Ghirlandaio owned by Pierpont Morgan with which I would dearly love to run away—a painting of the fifteenth century which looks so fresh. Yet even her beauty could not quench my critical faculty, and I noticed that the junction of her neck with her chin made a perfect right angle, a thing which I have never yet seen in Nature. The fact that a picture is worth a large sum of money does not necessarily make it beautiful, and I prefer things beautiful to things valuable. What does delight me is to see the sketches, such as those of Leonardo in this exhibition, which show how the mind of a genius, taking pencil in hand, draws a limb, a hand, a face in various positions and gradually evolves a masterpiece.

When all those portraits by Rembrandt were gathered together in Burlington House for the Dutch Exhibition of 1929 their effect was overwhelming, and all day long people worshipped them. I confess to a weakness for Rembrandt, but here again if I were given the choice of one of his pictures, not for what it would fetch in a sale room, but for the pleasure it would give me to place upon my wall, I would carry off his picture of "The Philosopher" in the National Gallery—the dark figure at the desk with the tracery of sunlight streaming through the windows never fails to appeal to me.

Italy, Spain, Holland, these countries have produced the greatest masters of painting, withal they are men of an age that is past. If Britain up to the seven-

teenth century had produced no body of work comparable with that of the countries named, she yet has no cause for shame in the work of her painters of the eighteenth and nineteenth centuries. Not until then did this country start to produce painters who began to tower over the heads of their contemporaries. Gainsborough for all his modesty was a great artist, and although his pictures now fetch enormous sums in the sale rooms, the far-seeing American millionaires who purchase them know full well that the millionaires of the future will give even greater sums to own such works. Sir Joshua Reynolds, who was Gainsborough's rival, was also producing magnificent pictures that were destined to become the old masters of the British school. Romney, too, was competing with Reynolds for the plaudits of the people, and if his work was not so good as that of Reynolds it still commands high prices to-day, and often excites keen competition in the sale room.

Of all the work of British artists who have passed away, that which appeals to me most comes from the brushes of Constable and Turner. Constable loved the open-air life of England so much, with its trees and lanes and cornfields, that he sought to perpetuate it for ever on canvas. Perhaps it is because I also love England and its entrancing scenery that Constable captivates me. Constable, like Rembrandt, was the son of a miller, and he seemed to observe Nature with a new eye.

The foe of artificiality, he was hailed in France as the great artist he undoubtedly was, his influence was profound enough to create a powerful new movement among French painters, and the gold medal presented to him by the King of France was a tribute to the discernment of the Frenchmen of those days as well as to Constable's art. All this was in sad contrast to the neglect he met with in England. He felt this lack of appreciation, but amid all his difficulties he went on painting bravely, and when the R.A. crowned him, it was, as he remarked, too late

As for J. M. W. Turner, none will deny his genius.

There is a big gap between the boy who lathered the customers in his father's barber's shop and the artist who gave us the glorious pictures on the walls of our National Galleries. As a boy Turner sold his little sketches for a shilling or two, while he was struggling he gladly gave a lesson for five shillings, and as a famous painter he obtained as much as he could get. Yet he was a soured, cantankerous man, with all the snarling ways of genius, keen to amass money and hating to spend it, existing in the most niggardly way, living a double life, nursing a grudge against the hostile critics who were too blind to see the beauty of his work, the wonderful atmosphere and sunlight which he caught on the point of his brush and fixed for our delight.

He lived for one thing—Art ? Painting was his god, and while he was worshipping at the feet of the old masters he was developing his own amazing facility with the brush. In some of his work—his best work—he was before his time. His fellows saw everything with photographic eyes, but he trailed a brushful of glorious atmosphere across the hard outlines and dimmed them to beauty—to the rage of the critics. There are some pictures in which you can see everything at a glance, but I prefer those in which you can see something fresh each time you look at them—and under some of the misty veils which Turner throws over his paintings the onlooker can see whatever he has in mind.

For all his perversity and sensuality and queer ways, Turner loved the land that gave him birth, and the poverty-stricken were gladdened by his money when he died, and the nation was enriched by the gift of all the pictures he possessed—a gift worth a fabulous sum in these days.

Nor must I forget one other outstanding figure who stalked across the canvas of English Art like a giant. This was G. F. Watts, who was one of the Old Masters reincarnate. To me his paintings seem instinct with something which he cannot quite impart to us ; he has ideas which he has tried to express, ideas which he has

hacked at and hewn and shaped on canvas, digging the picture out of his subconscious mind, barely understanding it himself, and hoping that those who followed on would be able to realize the heights which he attempted to scale. There is in some of the work of Watts something instinct of life which is struggling to express itself, a force rather incoherent, almost inarticulate, but powerful as the force of life itself.

Britain, admittedly, was late in turning her attention to the painting of pictures, but she has since won an honourable place among the nations, and her artists, like Turner and Constable, have had a deep influence on continental schools, while Gainsborough and Reynolds are reckoned among the greatest of the masters. Incidentally, the accuracy of Turner's observation receives a very fine tribute from Sir Robert Hadfield: "To a metallurgist it is hardly possible to conceive a more beautiful attempt to depict the different colours and shades of high temperatures than that shown in the wonderful picture, 'Mount Vesuvius in Eruption in 1818,' painted by that renowned British artist, J. M. W. Turner, R.A. The beautiful tones in this water-colour picture, which . . ., range from dull red to white heat; that is, they include temperatures from about 600 degrees C. to 1600 C., and are depicted in a marvellously artistic manner." When a scientist conveys a compliment to an artist in this manner, it is a very great compliment indeed.

One other art remains, the art of literature, and here it may truly be said that Britain is without peer. Nothing in the world is so amazing, nothing quite so difficult to understand, as the sudden blossoming of English literature during the time of Queen Elizabeth. For a century or so the mariners of Spain and Portugal and Britain had been opening up the world as though it were an oyster full of pearls. A virile activity was manifest. The discovery of new lands stirred the minds of men, new ideas were gaining currency, the magnitude of the earth was beginning to dawn on human vision.

A couple of centuries before the great Elizabethans burst into song, Geoffrey Chaucer laid the foundations of English literature with his *Canterbury Tales*. Boccaccio's *Decameron Nights* and Chaucer's *Canterbury Tales* have the same fundamental idea as a starting-point—a body of men gathered together, each telling stories to while away the time.

With Chaucer the narrators of the tales are thirty-six pilgrims who set out from the Tabard Inn in Southwark to visit the shrine of à Becket at Canterbury, and each was supposed to tell a tale to lighten the monotony of the journey on the way to Canterbury, and another tale on the way back. Unfortunately, Chaucer wrote only twenty-four of these stories before he died, so his plan is incomplete; yet these tales, narrated in metrical form, are sufficient without any of his other work to ensure him an immortal name. Chaucer lived in coarse times, in which they called a spade a spade, and some of his tales are as coarse as his times; but if they bring a blush to the modern cheek, their candour is still preferable to and less harmful than the salaciousness of some of the modern "Talkies" that insinuate themselves from Hollywood.

Chaucer, who was the son of a wine merchant, is generally supposed to have been born about 1340; regarding his death, which took place in 1400, there is no such doubt. Finding his way as a page to the Court of Edward the Third, he was fighting with John of Gaunt in France when he was captured by the French. The King himself helped to ransom Chaucer, which suggests that the future poet was as popular with the King as with his son John. The tie of friendship which undoubtedly existed between John of Gaunt and Chaucer was strengthened by a marriage tie in 1366, for Chaucer married the sister of John's wife. Thereafter he went on several Royal missions to foreign lands and served in different official posts. For a period he was the Comptroller of the Customs and Subsidy of Wool, Skins, and Leather, with a house in Aldgate which enabled

him easily to get to the port of London to attend to his duties. When he became Comptroller of the Petty Customs of the Port of London in 1382, he had already been engaged in his spare time for nine years in writing some of the *Canterbury Tales*, and after a year or two he took an assistant to relieve him of some of his customs duties and give him more time to devote to the *Canterbury Tales*.

The usual ups-and-downs that came to most people dependent upon the patronage of the Court came also to Chaucer, and on occasion he was actually in want. But a redistribution of power in Court set him up again, and eventually he was accorded a pension of the then goodly sum of £20 a year. A fat little man, with a blue eye and yellow beard, he was certainly a keen student of life, and the eighteen thousand lines of verse which he wrote give us a fairly clear impression of that age.

His passing left English literature without any outstanding figure until Edmund Spenser delighted Elizabeth by dedicating the first books of the *Faery Queen* to her. Like Chaucer, the author of the *Faery Queen* was unable to carry through his original conception, and he died with the *Faery Queen* still unfinished. Great poet though he was, he and the other fine poets of that brilliant age were completely overshadowed by Shakespeare. Regarded solely from the literary viewpoint, William Shakespeare is of course the greatest genius the world has ever known. Give to Germany her Goethe, allow to Italy her Dante, Spain her Cervantes, and France her Molière, yet all together are as the feeble flicker of a match extinguished in the blazing beam of a lighthouse when compared with Shakespeare. Few foreigners outside the countries named will dispute this, and many in them will admit it.

A great library of books has been written about our national poet, whose love for England has survived in many an unmatched line. No matter in what light Shakespeare be regarded, he is amazing, and probably until the end of time there will be wordy warfare between

scholars as to whether Shakespeare was well-educated or not. For one so famous, we really know very little about him. That he was the son of John Shakespeare and went to Stratford-on-Avon Grammar School are proven facts, as is his christening on April 26, 1564. But whether he was born on April 22 or 23, or a week or two earlier, no one can say with assurance: the date has merely been fixed because it was the custom for children to be baptized about three days after birth.

John Shakespeare, who dealt in various things and was also a glover, made his way among his townsmen in Stratford until he became the Mayor of the place, and during these years his son William was going to and from the Grammar School, learning as little or as much as he chose. Ben Jonson wrote that he had "little Latin and less Greek," while another writer contradicts him so far as Latin is concerned. Nor is Jonson alone in suggesting that Shakespeare was lacking the highest culture of his time. It may be so. We shall never know. Certain it is that if he was not learning at school, then he was learning in the fields and hedgerows of old England, for again and again in his sonnets and plays his love of Nature crops out. Judging by the remarks in one of his plays, it seems likely that he was had up before a magistrate for poaching. But the great drama of Shakespeare's life, the first great drama, is carried on off stage. On the facts we may perhaps be justified in hazarding a guess as to what happened to lead up to his marriage to Anne Hathaway. Anne was eight years older than Shakespeare, who was only eighteen when he married her in November 1582. Six months later their first child was born. Whether Anne deliberately used all her wiles and resources to capture the Grammar School boy, or whether Shakespeare went too far in his trifling with her is an open question. The fact that Shakespeare left her in his will their bed has something suggestive about it.

When Anne found that a child, with all the attendant disgrace it brought in its train, was looming out of her

THE LONG, TIMBERED BUILDING IS THE ANCIENT GUILDHALL ADJOINING THE GUILD CHAPEL AT STRATFORD-ON-AVON. THE UPPER STOREY OF THE GUILDHALL IS THE GRAMMAR SCHOOL IN WHICH SHAKESPEARE USED TO SIT LEARNING TO READ AND WRITE. HIS TEACHER PR[illegible] ABOUT TO DOING HIS LESS[illegible] TO A BRILLIANCE WHICH STILL DAZZLES AND PUZZLES THE WHOLE WORLD

association with her lover, her concern can be imagined. There were undoubtedly family upheavals on both sides, conferences between the parents, and it is thought that Shakespeare's family were dead against the match. Whatever Shakespeare's real feelings may have been in the matter, he was chivalrous enough to marry Anne and save her good name by giving her his own. And within a year after the birth of his daughter he became the father of twins.

For a little time the youth, who had suddenly thrust upon him the responsibility for keeping a family of three children and a wife, remained in Stratford. Anne, with one child barely out of long clothes and two more infants on her hands, must have found plenty to do. Other women have become short-tempered in such circumstances : it is perhaps a little natural, and although there is no evidence to bear me out, she may have been slightly difficult to live with.

As Shakespeare's father was also meeting with financial troubles, there was perhaps reason, and to spare, for the young Stratford man setting out to seek his fortune in London. It may be, and in fact it is exceedingly likely, that the reasons for Shakespeare leaving Stratford were very painful to him, that he would not have left if he could have been assured of a decent living in his native town. Whatever were the difficulties which drove him away, we must always be profoundly grateful that they existed. If they pained Shakespeare, they have since brought the whole civilized world unbounded pleasure, for had Shakespeare not been driven from home, his genius would probably never have flowered into those sonnets and plays which are the world's delight.

" Hold your horse, sir ? " used to be a common cry from the small boy to the horseman in the not so olden days. And rumour has it that Shakespeare, on his first appearance in London town, was glad to get a living by looking after horses outside the theatre. If he did, he soon managed to find out the secret of how to graduate

from holding horses outside the theatre to acting as call-boy inside, and once that step was won the rest would follow naturally. From a chance remark of a man of the period, he must have been at everybody's beck and call—an odd man, running out to get a pot of beer for the actors, helping with their costumes and prompting the actors when such fellows forgot their lines, which was not seldom. The theatre then had a plain stage without scenery, and the actors were obliged to rely upon the humanity of the parts they played to interest their audiences. There were no pretty girls to appeal to male playgoers, because all the parts for girls were played by young men ; there were no displays of neat ankles and legs and wonderful scenery such as attract the modern eye. If the play was not human enough to hold the interest, then it was doomed to fail, because there was nothing else whatsoever to help it to succeed.

When he got his first chance to act, I have no doubt that Will Shakespeare imagined that his fortune was made, as indeed it was, for in after years he made a very great deal more as an actor than he did as a playwright. If he got £20 for a play, he was being very well paid, whereas he earned as an actor up to £130 a year, which was a huge sum then.

Nobody seems to know where and how his wife and children were living during these days, but it seems probable that Anne Hathaway's mother was taking care of them in Anne's old home at Shottery, near Stratford. As Shakespeare's father-in-law was dead, and Shakespeare's father was hard put to make ends meet, while Mrs. Hathaway was in fairly comfortable circumstances, it seems feasible that she would take care of her daughter and grandchildren.

Anyway, Shakespeare must have worked hard and saved money, for by 1597 he managed to buy the biggest house in Stratford—New Place—to which he afterwards retired, after purchasing several other parcels of land in the neighbourhood.

There seems no doubt that he received as little as

£6 for a play—he was lucky if he got £15; and as a playwright it is doubtful if he made much more than £20 a year. He managed, however, to acquire a share of the Globe and other theatres, and from these he made a good deal of money. Indeed, Shakespeare when he retired was a wealthy man. The greatest mystery concerning this genius is how he wrote his plays and in what circumstances. At first he tinkered about with other men's plays—rewrote scenes and polished them to make them more suitable to present to the public. In this respect he acted as sub-editor of plays, and I can imagine Burbage or someone flinging him a script and urging: "Try thy best on this!"

Going away, Shakespeare would sit at his table with quill and inkhorn and cross out and rewrite and breathe humanity into the puppets he found on the paper. I fancy he did it quite easily, and thought naught of it, just as a sub-editor tackles his work in our own time. I have known sub-editors to write a page or a column or more of a serial story, quite unknown to the authors of the story, when it has happened to fall too short for the issue in question, and think no more about it than they think of yesterday's lunch. And I feel sure that the great poet essayed his earlier revisions in a similar light-hearted manner, as being all in the day's work. It is by no means unlikely that, given a particularly bad play to deal with, he concluded that it was far easier to write a totally new play than attempt to patch up the old one, and thus his hand was set to writing those tragedies and comedies which are the glory of all mankind. We have no proof that this is so, but my knowledge of his first steps and of the way a man's brain works indicates that this was the likeliest way of all.

For about twenty-six years Shakespeare led a busy life in London, and during this time he compassed all the plays we know, including his poems and his incomparable sonnets. By 1611 he retired to lead the life of a country gentleman at Stratford; but he enjoyed his leisure amid the pleasant surroundings of his boyhood's

days for only five years before he died on April 23, 1616, a day generally considered to be the anniversary of his birthday, but his birthday I feel sure was at least several days earlier. At the age of twenty-two he was quite unknown; at fifty-two he died, the greatest literary genius the world has so far known. And whatever may have been his belief in his powers in those first early years, by the time he had written his sonnets—and what lovely things they are!—he knew he had achieved immortality, for he boldly states that his work will live when he is dead. Yet some of the first editions of his plays, for which collectors to-day would bid thousands of pounds, were published and sold at sixpence each!

By sheer genius Shakespeare achieved what he did. Those who denied him learning in the accepted sense were probably right. He had much more than that. A hint to him was better than a course of lessons to any other man. He could take the rumours and reports and the idle chatter of his days and weave them into works of splendour. Ben Jonson, who was sufficiently inspired to throw down the bricklayer's trowel and pick up the quill and give the world some fine plays, and poems like the divine "Drink to me only with thine eyes," recognized him as Master. Jonson and Lovelace—"Stone walls do not a prison make, nor iron bars a cage"—the great Lord Bacon, whose essays would add to the literature of any race, these and others will bear no comparison with Shakespeare. Yet had Shakespeare not lived, they would have been accorded the greatness that was and is really their due.

When John Milton was born in Bread Street, Cheapside, on December 9, 1608, Shakespeare was at the height of his fame, filling the stage and the life of his time, welcome at the Court of Elizabeth, and envied by many whose malicious tongues said unkind things about him. The Greek and Latin that Shakespeare lacked were quite familiar to Milton as a boy, and his delicate airs and feminine appearance led his fellow-undergraduates at Cambridge to nickname him "the lady."

From his father Milton inherited a love of music, and the *Faery Queen* and other poems of Spenser appealed strongly to his mind. Yet Milton lived in a twilight of gloom, an austere man, holding aloof from the pleasures of his age, sensing himself as a man apart, feeling beauty, but not mirth, in his heart. Before he left Cambridge he wrote some of his well-known sonnets and poems, and during the time he lived with his father " Il Penseroso " and " L'Allegro " came from his pen.

It is the greatest of pities that he should have been mixed up with politics, and that so many of the best years of his life were devoted to writing on matters that a lesser man might have dealt with, instead of devoting his genius to the poetry that was in his mind. It is difficult to visualize anything more pathetic than the great poet, stricken by blindness, dictating the sublime lines of *Paradise Lost* to his daughters, the women girding at the tie which made them subject to the whims and fancies of their father's genius. To them, I fear, he was a nuisance, and the writing of *Paradise Lost* a severe penance. But if they felt undutiful, they yet performed their duty, and they have earned the thanks of all who came after.

A man of very decided opinions, and decided opinions are one of the stamps of genius, Milton considered that Charles the First deserved to be beheaded, yet this follower and helper of Cromwell fell in love with a Royalist and married her. When husband and wife spring from opposite camps it would be something of a miracle if the course of love ran smoothly. She was only seventeen, and in a month she went back to her parents, while Milton, who no doubt felt strongly on the subject, was soon writing on divorce reform. A couple of years later, when the poet held an official post under Cromwell, his wife returned to him. But he was destined to have three wives before he died, on November 8, 1673. It is instructive, in view of the large sums paid for some books in these days, to know that for *Paradise Lost* the poet arranged with his publisher

Symmons to pay him for the first edition of 1500 copies the sum of £5, with a similar sum on the second and third editions, or £15 in all. Obviously cash is no test of quality.

A mere recital of the names I should touch on before closing this chapter would just be tedious. Because I like "The Skylark," I will mention Shelley, but only to record my opinion that Meredith's poem of "The Skylark" is infinitely finer, this being a great favourite of mine, along with his "Love in a Valley." The music of Swinburne, too, appeals to me, particularly "Itylus." I can lay my hand on my heart and tell how I have read Dante from end to end with delight—and not many who talk about him have read him—but although I have been through *Paradise Lost*, the sequel to it, *Paradise Regained*, is still a closed book to me. And I find that Shakespeare's sonnets are an excellent corrective to an overdose of modernism.

Perchance the detractors of Britain are inclined to smile and remark that I dwell on past glories, that Shakespeare and Milton are no more. And then I remember a little boy who helped to make blacking, and lived to make something approaching literature—a boy who grew up to be Charles Dickens, with a sense of caricaturing a character that endeared him and still endears him to the hearts of millions of readers. Dickens is still close to us. Closer still is Thomas Hardy, a greater genius rooted deep in English soil. There are many of discerning taste who rank Hardy the poet as a greater artist than Hardy the novelist. He does not strike me like that. He is so native, so English, such a part of our glorious countryside that a century hence I expect the poet will take second place to the novelist.

It is a sense of fitness which compels me to mention the man who is undoubtedly the greatest of living authors—no, it is not Galsworthy, Wells, nor Bennett, but Bernard Shaw. Already his work is dating, for some of the reforms he fought for have long come about and left his works and their special pleading on the dust-

heap of yesteryear. Whatever the future may say of Shaw, and whatever he says of himself, to-day he is without doubt the world's greatest literary force. The Irishman has upon occasions coupled his name with that of Shakespeare, and sought to gain a little of the reflected glory of the Englishman. And the English, being built that way, have enjoyed the joke and paid tribute to Shaw's infernal cleverness.

It is obvious, when the whole field of art is reviewed, that while in music Britain has not played much of a solo part, in painting, despite a late start, she has produced some masters who have made an indelible mark on the world, and in literature she holds the supreme place, with the genius of Shakespeare so great as to be almost superhuman.

Consumption, perhaps, gave Keats his touch of genius, and his " Nightingale " will always sing sweetly to me ; Burns has a humanity and strength that are very vital. But although other countries have tried to claim him for their own, there is only one Shakespeare.

And he is English.

CHAPTER XIII

SOME SCIENTIFIC TRIUMPHS

ALTHOUGH Queen Anne is undoubtedly dead, I may, perhaps, be permitted to pay a posthumous tribute to her. Not only did she provide us with a figure of speech for describing all things obsolescent and out-of-date, but before passing away she consented in 1705 to grant a knighthood to Sir Isaac Newton, and thus provided the ages with proof that the wise ones of her day had the ability to recognize and the humility to honour one of the greatest men who ever lived. For sheer intellect, Newton has no parallel, and I do not suppose that the miracles of mathematics he accomplished will ever be understood by the masses of the people. In the nature of things this must be so, for it is not necessary for the man who sweeps the street or builds a house to have a knowledge of the differential calculus, because he can manage to live quite happily without it. And the painter who slips off a ladder realizes that he must fall to the ground : he obeys the law of gravitation without understanding it.

Most of the people in the world do the same even to-day, and all of them did up till the time that Newton began to study the problem. People had stumbled and fallen, they had thrown sticks and stones at dogs and watched them come to rest on the ground, every autumn they had seen countless leaves fall from the trees and float slowly to earth, without troubling their heads as to why things should behave in this fashion. Nobody troubled to inquire why, when a branch snapped off a tree, it did not shoot straight up in the heavens and

disappear from sight, or why a stone thrown into the air did not vanish for ever into the clouds.

"How ridiculous!" you will say. "That is impossible!" Which is perfectly true. But nobody knew why it was impossible until Newton with his wonderful brain worked it all out. They simply obeyed and saw everything else obey this most fundamental of all natural laws without knowing anything about it, without knowing that the law existed.

When Newton was born at Woolsthorpe in Lincolnshire on Christmas Day in 1642 his father was already dead. His mother occupied the Manor, a house of moderate size, and cultivated sufficient land to be regarded as a landed proprietor. The church bells that Christmas heralded the birth of no mean son of man, as the years were to prove. Yet Newton showed no indication of possessing remarkable ability in those early days at Grantham Grammar School. He was far too shy and retiring to make his quality felt. His grandmother, who took care of him and the Manor when his mother remarried, did her best to make him a farmer, but his mind was on other things. So at the age of nineteen he went to Trinity College, Cambridge, and there fell under the spell of mathematics, in which science he was destined to become the cleverest exponent of all time.

By 1665 the black plague started to alarm the city of the Fens, people of Cambridge began to die, and students were stricken down, so they went to their homes until the plague had abated. And it was now that Newton, idling away his time under an apple tree in his grandmother's orchard, saw an apple fall from the tree and land with a soft plump on the grass beside him. There are many stories of Washington and other famous men which are not true, but the incident of Newton happens to be authentic. Countless apples had fallen before and have fallen since. Newton himself must have seen them falling many times, and often he must have walked over to an apple after it had fallen,

picked it up and buried his teeth in it without giving it another thought except to enjoy the flavour of the fruit. In the average of things, it must have been so. Had that apple fallen a day or even a minute before or after it might have fallen too early or too late. But at that particular moment of time, Newton's brain was in the particularly receptive mood to realize that the commonplace sight of an apple falling was really one of the greatest miracles in life, he began to speculate why the apple should drop instead of rise, and thus started the train of thought which led him to discover the universal force of gravitation, the attraction that greater bodies have for lesser, that all things obey, from the things so small that they cannot be seen under the most powerful microscope to the things so huge like the planets in the skies that the human brain fails to comprehend them.

The whole universe is balanced by gravitation. The moon is suspended in the skies by gravitation. It feels the attractive force of the earth and cannot get away from it, so it swings round and round the earth on an invisible leash ; while the earth feeling the pull of the sun swings round and round the sun, carrying the moon with it in the same orbit, so the path of the moon round the sun spirals round the orbit of the earth like a corkscrew.

Many people have been to exhibitions and fêtes and enjoyed the fun of seeing people trying to maintain their position on a circular platform, highly polished, that spins faster and faster until it flings them sprawling over the side. That is exactly what would happen to all the houses and trees and people on the face of the earth as it spins rapidly round the sun, were it not that the force of gravitation is powerful enough to hold all these things in place. They would just shoot off the earth and go on and on, speeding through the air like comets, and if they passed through our atmosphere without being burned up by the friction, then they would never stop, but go on for all eternity. And, of

course, our atmosphere would shoot off as well—but there is no place here for the queer things that would happen if gravity ceased to be.

While still a young man of twenty-four, Newton made his mathematical discoveries which have proved so important to that science. But when, through his mathematical genius, he strove to prove his theory concerning the force of gravitation by working out his calculations in connection with the orbit of the moon, he simply could not do so. His calculations were almost right, but not quite right. There was a difference which he could not understand or explain—if his theory were really correct.

Knowledge is built up slowly on the discoveries of many men. The German astronomer Kepler had managed to wrest the secret of planetary motions from the heavens, and it was with Kepler's laws that the mind of Newton concerned itself when his eye saw the apple fall. A wider divergence than that which existed between a planet and an apple could not well be imagined, yet in Newton's mind they were clearly linked and obedient to the same laws. But when all his calculations were made, there was an error for which he could not account, and rather than run the risk of announcing something which was inaccurate, he put his work on gravitation aside, and turned his attention to the study of light, which, by passing through a glass prism, he split up into the usual band of the spectrum, or well-known colours of the rainbow. He proved that what we regard as white light is really a combination of coloured lights. That was a great discovery,

It was in connection with his studies on light that Newton made the first reflecting telescope, and although Galileo is commonly given the credit for inventing the first telescope, there is printed evidence existing at Oxford University to-day to prove that Leonard Digges, of University College, constructed a telescope many years before Galileo achieved the same invention. This is one more case of Britain anticipating other nations,

who have somehow managed to gain all the credit. On this particular point of the invention of the telescope there is no doubt.

Roger Bacon, that most amazing scientific monk, wrote in 1265: "Glasses or diaphanous bodies may be so formed that the most remote objects may appear just at hand, and the contrary, so that we may read the smallest letters at an incredible distance, and may number things, though never so small, and may make the stars also appear as near as we please."

According to Mr. R. T. Gunther this prophecy lay unheeded for three centuries, until Digges, coming across it and being inspired by it to achieve this seeming miracle, eventually succeeded in inventing and constructing a telescope.

To revert to Newton, in January 1672 a paper was read before the Royal Society describing the exact measurement of a degree of meridian by the French astronomer Picard. This determined the exact dimension of the earth, and it was the very thing that Newton was waiting for. In the light of this new knowledge he resumed his studies on gravitation and found that, simple as was the apparatus by which he had arrived at his calculations, he was right after all. So he worked out his famous laws of motion and his law of gravitation, telling none of what he was about. Even when Halley, the famous astronomer who accurately foretold the coming of Halley's comet, learned of Newton's discovery, the latter was loath to publish it, so Halley eventually paid for the printing of the *Principia* out of his own pocket, and in 1687, over twenty years after Newton saw the apple fall, the work which has revolutionized the thought of mankind was published.

Newton was the simplest of men, whose whole interest was wrapped up in science, and all the mundane things of life were arranged by his niece, with whom he lived. He took his meals, like other men, when they were served, but five minutes later it is doubtful if he could

tell you what he had been eating or drinking. For his first experiment with light, he simply bored a small hole in the shutter over the window and let the beam of light shine on his prism of glass. And although the great man had a fondness for a cat and a kitten, he had a rooted dislike to interrupting his work to let them in and out of his room, so he cut two holes in the door—a large one for the cat and a smaller one for the kitten. It goes to show how the greatest mind may trip up over the most trifling things. This humble man, whose sheer intellect outsoared that of any man before or since, died in March 1727, and was buried in our national shrine at Westminster Abbey.

On the death of Newton, Pope wrote his famous epitaph :

> "Nature and Nature's laws lay hid in night :
> God said, 'Let Newton be,' and all was light!"

Long years after Dr. Young had opposed Newton's theory that light was caused by a stream of minute particles, a brilliant Scottish scientist, Clerk Maxwell, formulated the theory that light was actually a series of waves in the ether, and that electric waves shot through the ether at the same speed as light. With his fine mathematical mind he was able to work out the length of his electric waves, although he could not detect them and all other men denied their existence. But the publication of his theory led Hertz to study the subject and detect the very electric or wireless waves the existence of which the Scot had proved by his mathematical formulæ, and when the electric waves were measured the Scottish scientist was once more proved to be right.

Astounding as are some of the feats of British mathematicians, one of the most spectacular is that of the discovery of the planet Neptune by Professor Adams. Uranus, one of the most distant planets from the earth, did not quite pursue its proper course. There seemed to be a slight deviation, so minute as not to be worth

noticing, an irregularity so trifling that no astronomer could be sure that it really existed. On this slenderest of all clues, Adams set to work in July 1841, and proved on paper that another planet existed on the far side of Uranus, and that it was the pull of this planet, now known as Neptune, which was responsible for the slight variation in the motion of the known planet. By the most abstruse calculations, Adams decided where the new planet would be found, and he indicated its size. Sure enough in 1846 Neptune was found there — a wonderful tribute to the power of the mathematical mind, and the trifling thing in science which so often leads to big results. The French astronomer Leverrier, also achieved fame by discovering Neptune independently at the same time.

Joseph Priestley's discovery of oxygen in 1774 was of the highest importance, but at the moment he did not know exactly what he had found, and regarded it as the purest form of air. Observing that a candle placed in the gas burned brighter than any he had seen before, he caught a mouse, and as the little animal displayed marvellous energy when placed in an inverted vessel full of his new gas, he breathed in some of the gas himself and realized that it sharpened his senses and made him feel quite lively. He achieved his discovery by heating oxide of mercury. The son of a humble textile worker, and a minister by profession, Priestley held very unorthodox views, and his mind was much more concerned with science than with religion. So unorthodox were his views that a Birmingham mob got out of hand in 1791 and burned down his house and chapel, driving the disgusted scientist-clergyman to London and eventually to the United States.

Sir Humphry Davy was another of the great scientists who added lustre to the name of England. Son of a carpenter and wood-carver, Davy was fortunate in attracting elderly friends who helped him with his education, and were not adverse to his experiments. His discovery of the power of nitrous oxide, or laughing

gas, as it is generally known, led him, after testing it on himself, to suggest that it would prove of great benefit to surgery. But the surgeons of his day, as mentioned in an earlier chapter, were much too blind to avail themselves of his discovery which he announced in 1800, when he was only twenty-one years old.

Discovery followed discovery when he became assistant at the Royal Institution, and his electrical method of breaking down a compound into its components disclosed the elements of potassium, strontium, barium, calcium, sodium, and magnesium. Important as were these and other discoveries, his name will be most familiar as the inventor of the Davy lamp, the safety-lamp which he invented to lessen the risks of coal-miners.

There are few stories more fascinating than that of this son of a Cornish carpenter whose genius made him one of the greatest scientists and chemists the world has known. "Self-made" he used to call himself, and it was true. His genius to-day is obvious, and his greatness was made plain when he read the appeal of that unknown bookseller's boy and gave that boy the chance which he sought to serve Science—when he referred to Faraday as his greatest discovery, who will deny it? Davy and Faraday both served science to the best of their ability, and their work conferred a boundless benefit upon the whole world as well as honour upon Britain.

In no other branch of science has the genius of Englishmen shone brighter than in the search for the infinitely small, and it was John Dalton who first formulated the atomic theory, and produced evidence to support it. Dalton, who got a meagre living by teaching, and carried out his experiments on gases and other things when and how he could, did for chemistry what no other man had done. He laid its foundations as a science, and his book, *The New System of Chemical Philosophy*, issued in 1804, created a sensation as well as opposition from many scientists of the first rank. He took the atom of hydrogen as his unit of weight,

because it was considered the smallest and lightest atom of all, and measured the weights of twenty-one materials which were regarded as elements. It was a brilliant feat.

This poor Quaker teacher and scientist was always working, and the curse of colour-blindness from which he suffered led to more than one humorous episode, as well as to his discovery that human beings suffer from this defective vision. An amusing chapter could be written about his many eccentricities, but it is hard to beat his voting that the doorkeeper should be the President of the Manchester Philosophical Society. All Manchester paid homage to him as a great scientist when he died in 1844, and what Manchester thinks to-day, it is said that the whole world thinks to-morrow. In this case, at any rate, Manchester was decidedly right.

While the atomic theory was mentioned by the Greeks well over two thousand years ago, it was left to this son of a poor Cumberland weaver to grapple with the mystery of the atom, and by a long series of experiments produce his table of atomic weights which made him one of the founders of modern chemistry. The Royal Society gave him its first Royal Medal for his great discoveries, and other scientific societies honoured him, but it was long before this simple man with the extraordinary brain could be induced to accept a pension of £300 a year to enable him to carry on his work in greater comfort. The simplest things sufficed for his wants, and he lived and died a bachelor, thus being able to devote himself entirely to work undistracted by the domesticities.

Dalton's eccentricities developed later in life, but Henry Cavendish, who was born in Nice in 1731, was unusual from the beginning. This grandson of the Duke of Devonshire was left a fortune by an uncle, but he did not worry about it. Spending what he wanted, he allowed his bankers to take care of the rest. He practically lived on mutton in a big house on Clapham Common, and he turned the house into a series of work-

rooms for the various branches of science that he studied. He saw no one, barely spoke even to his servants, and spent all his days working at his experiments. He would have laughed at the idea of anyone assuming he was lonely. He had so much to think about that he had no time to be lonely, in fact, he had hardly time to be human, so divorced was he from laughter and happiness as the latter term is generally understood.

Yet, in his own way, he was probably supremely happy, but it was not the usual way. He just shut out the world and worked, and his greatest discovery of all was as astonishing and revolutionary as was ever made. Since the beginning of time, water was regarded as one of the elements, absolutely unchangeable. Cavendish happened to be experimenting with the gas hydrogen and with that other gas oxygen, without which human life would die out. He was mixing them in a brass globe and passing an electrical charge through the contents, and after doing this several times he found, to his astonishment, that there was water in the globe.

That day he made two wonderful discoveries—that water was actually composed of the two gases—oxygen and hydrogen—and it was not therefore one of the elements ; and that he had succeeded in wresting from Nature this marvellous secret of how to fuse two gases and turn them into water. Cavendish accomplished many other things, but this is his outstanding discovery. At his death, this aristocrat, who was the most eccentric scientist who ever lived, left a fortune of over £700,000, and the Cavendish Laboratory at Cambridge, in which another miracle has been accomplished in our own time, was built as a memorial to this strange, but brilliantly clever man.

Quite as astounding as the finding of Neptune in the skies was the discovery of helium on the earth. At the present time the United States is the only country in the world that is able to fill its airships with this rare gas which, being non-inflammable, makes an airship much safer than one filled with hydrogen.

Over sixty years ago the light given out by the sun was being examined by the spectroscope when some unusual lines were detected in the spectrum. Perhaps I should explain that all the known elements when in a state of incandescence give out certain bands of colours in the spectrum, and by heating the elements found on earth and examining the bands they make on the spectrum, it has been possible to trace similar elements in the sun and stars. This unmasking of the elements found in the sun and stars is one of the most marvellous pieces of scientific detective work ever performed. Well, on this particular occasion in 1868 when these strange lines were first detected, no one could say what they represented, because nothing on earth was known to give out similar lines, so science concluded that a new element had been discovered, and as it was found in the sun, it was called helium.

Now those who imagined that this new element was all moonshine were making a grave mistake. To the trained eye the spectrum cannot lie, although some eyes see clearer than others, and a shadow to them means more than it does to the next man. The periodic table of the elements which Mendeleeff drew up was found to have several gaps in it, as though, in a fence of split stakes, one was missing here and there. The gaps in the sequence were obvious, and science said that these gaps represented elements yet to be discovered, and that the said elements would have certain characteristics and atomic weights which would bring them into their right place in the table.

Sir William Ramsay, who was born in Glasgow in 1852, was destined to throw considerable light on these unknown elements and wrest more than one secret from Nature. Chemistry was in his blood, and a course of lectures under Kelvin served to widen his outlook and lay a fine foundation of knowledge. By the time he was twenty-five he was Professor of Chemistry at University College, London, and it was in London that the Scotsman made his most brilliant discoveries.

Lord Rayleigh, a peer who might have spent a life of pleasure, but who preferred to labour for science and his fellow-men, threw in his lot with Ramsay, in a joint effort to trace one of these missing elements. Rayleigh, in checking the atomic weight of nitrogen, found a slight discrepancy in the two forms of nitrogen with which he was experimenting. One form of nitrogen he obtained from the air, and the other from ammonia, but pure nitrogen should weigh the same from all sources, yet in this case a checking and rechecking convinced him that the nitrogen from the atmosphere was slightly heavier than the other.

In science the trifles count, and he and Ramsay set out to find what caused atmospheric nitrogen to weigh more than the other. After a series of experiments they isolated an entirely new gas which they called argon. It was a great triumph of mind over matter. But Rayleigh even now was not satisfied. Argon was responsible for some of the extra weight, but a series of experiments convinced him that when the atomic weight of argon was added to that of nitrogen, a slight difference still remained : it required something else to make the scale absolutely balance. So Ramsay tracked the missing gas to its lair.

But the discovery on which his fame rests was the tracking of that unknown element in the sun upon this earth. In the gas given off by the mineral named cleveite he first detected helium. Then working with Professor Soddy, they collected the emanations given off by a minute quantity of radium, and when they came to examine this gas in the spectroscope they found it was helium also. Sir William Ramsay did more ; he fused some glass tubes through which X-rays had been passed, and saw those magic lines of light which indicated that not only helium and argon were present, but also neon. He was successful later in collecting helium and neon from similar glass tubes. For ages the search for the philosopher's stone which would transmute one metal into another has agitated the

minds of men, but Ramsay by his discovery proved that the changing of one element into another is actually going on all the time.

Sir William Crookes, who was a pupil with Perkin under Hofmann, obtained a greater vacuum in a glass tube than had ever been obtained before ; he exhausted the tube until there was only one-twenty-millionth part of air left in it, an important accomplishment that has proved invaluable for electric lighting. But many more people will remember his name and thank him for the discovery of the special glass, named Crookes' glass, which has proved such a blessing to those with defective vision.

For over ninety years Dalton's atoms held the scientific field as the universal brick out of which Nature built up everything in existence. Scientists accepted the atom as the smallest thing of all. Dalton called atoms "the ultimate particles." Then Sir William Crookes, sending a powerful electric discharge through one of his vacuum tubes, found that something within it glowed most beautifully. Realizing that it was unusual, something which he could not quite understand, he used the same words which Faraday had used so long before and termed this glow Radiant Matter, and he said that in this manifestation man had within his grasp the indivisible particles composing the physical basis of the universe.

Then Sir J. J. Thomson set to work in the Cavendish Laboratory at Cambridge, of which he is the head, to track down these tiny molecules of radiant matter and find out all about them. In some of the most cleverly thought-out experiments ever made he solved the problem of what they were, how fast they travelled, and their size. In 1897 he announced the results of his experiments and the discovery of the electron. The scientific world was literally staggered. It was as though all their lives the scientists had firmly believed that the brick of which a house was built was the tiniest of known things, and Sir J. J. Thomson came along and showed

them for the first time one single particle of those countless particles of clay which go to make a brick.

It was one of the most stupendous discoveries ever made, and the atom was proved to be mighty indeed compared with an electron, for if the atom were regarded as being similar in size to the dome of St. Paul's, then the electron would be about the size of a pin's head ! By using magnets and other electrical devices, the electron was proved to be a particle of negative electricity ; and by sending a charge of electrons through a water vapour, each electron condensed a drop of water—just as the blade of grass condenses a drop of dew, which is formed from the water vapour in the atmosphere—and the size of the electrons was determined by carefully timing how long a drop of moisture took to condense and float to the bottom of the tube ; then by measuring the water that was condensed, the scientist was able to count how many electrons he had shot into the tube. The electron was found to move at the rate of about 20,000 miles a second, and the theory generally accepted to-day is that an atom is a universe on a minute scale, composed of a proton and electrons which move rapidly within the space of the atom, rather like the way in which the planets move round the sun. For the moment, then, the electron is regarded as the zero of smallness, but in another century it may be looked upon in its turn as a minute universe composed of some tinier, newly discovered particles which, for want of a name, we may call " energons." Who knows ?

I regret that I have no space to deal with many other British scientists whose work is worthy of note, but my aim throughout has been to touch on those truly great scientific discoveries in which Britain has admittedly led the world. Into this category comes the work of Sir James Dewar, the co-inventor of cordite, whose genius as a physicist has benefited every home.

Those people who imagine that zero on the thermometer indicates the coldest temperature known may be surprised that the zero of Fahrenheit is regarded by

the scientist as being comparatively warm. Temperatures of 70 degrees below zero are met with on the earth and in the air, but this is not really cold—to the scientist, although it is sufficient to freeze him to death very quickly if he has no protection against it. Science aims at the absolute zero, a temperature so low that it is impossible to go lower, and to attain this goal may be compared with the feat of an explorer reaching the North or South Poles. As a matter of fact, to reach absolute zero is practically impossible, and no man has yet accomplished it, any more than any man has attained that absolute vacuum of which Sir William Crookes and other workers have been within measurable distance.

It was in realms of cold, compared with which the temperature of the North Pole would be as the temperature of the equator, that the genius of Sir James Dewar accomplished feats never before performed. In a series of experiments that were extremely dangerous, owing to the risks of his vessels exploding, he produced degrees of coldness that no other scientist had dreamed of. He carried the temperature down to a hundred and two hundred degrees below the zero of the ordinary thermometer. Still further into these frigid zones he explored, attaining temperatures lower than any ever known in a natural or artificial state on the earth, until he reached 13 degrees absolute, or, to use an everyday term, 470 degrees of frost.

Sir James, who was born in 1842 and educated in Edinburgh University, managed with ease to turn large quantities of oxygen gas into a liquid form; he went further and for the first time succeeded in liquefying hydrogen gas. And not content with these achievements he went on to freeze liquid oxygen and hydrogen until they were absolutely solid. In fact everything known to science becomes solid at the low temperatures he reached—everything except the gas, helium, which was discovered by Sir William Ramsay. This has since been liquefied in Holland.

The world owes a debt to the father of Lord Melchett for financing these long and costly experiments, yet great good to science and to the masses came out of them, for it was in connection with them that Sir James Dewar was led to invent the famous vacuum flask in order to store up his liquid oxygen. Unfortunately it was the Germans who seized on the wonderful possibilities of the vacuum flask in everyday life, and they manufactured them on such a large scale and exported them so widely that most people to-day are still under the impression that the vacuum flask is a German invention. It is a pleasure to record that a British scientist gave this great boon to the world. To Sir James Dewar, who died in 1923, it was merely an incident in many researches designed for the benefit of mankind, but his flasks in everyday use now amount to many millions.

CHAPTER XIV

OUR DAILY BREAD—AND MEAT

"GIVE us this day our daily bread" is the cry of Life itself for bare sustenance, and those who have devoted their talents to improving the harvests of the earth and increasing their yields deserve unbounded praise.

If any blame be due for changing the world from its slow-moving and archaic rural domesticity into the present feverish round of industrial activity, it must fall upon the shoulders of Britain; if any thanks be due, then Britain has earned them in full measure. For here in these islands were born those who dreamed of the machines that were to do the work of men; it was here that the inventors slaved and starved to make their dreams come true. Their motives were so mixed that it is doubtful if even the inventors could sort them out with certainty, but to the central creative urge must be added a little of the desire to acquire wealth and fame. But the easier life is made, the larger the family will become, for machinery will support a bigger population to the square mile, will give a livelihood to a far greater number of people than will the soil. And in a century of industrialism the population of Britain has trebled—the machines are enabling three people to exist where one existed on the soil before.

Moreover, in spite of this increase in population, the people to-day are actually better off in every way than were their forefathers; they are better clothed, better housed, better fed; they work shorter hours and enjoy more leisure; there is an infinite variety of amusements for them—cinemas, theatres, all sorts of open-air sports—

while all can pass away the time by reading cheap books and newspapers such as were unobtainable a hundred years ago ; silks are replacing the hard-wearing cloths and cottons which used to last women half a lifetime ; and sixty or seventy years ago the working-classes regarded meat as a luxury, which they enjoyed perhaps once a week, while white bread was a similar luxury when compared with the coarse brown bread that was commonly eaten : indeed, in some counties, the children used to refer to the white bread as " cake " and regard it as a great treat. Now the working-classes think nothing of eating meat three times a day, and white bread is their staple diet. These improvements are primarily due to the increased wealth produced by the machines which this country first created and taught the world how to use.

But there is another field in which this country has laboured with magnificent results that remain practically unknown except to the few : this is the field of Agriculture. To add to the harvests of the world by ever so little is to confer an inestimable boon on humanity ; if wheat could be made to yield another bushel or two an acre, bread should be cheaper ; if the grasses of poor pastures could be improved, they would support more cattle ; if cattle and sheep could be increased in size, clothing and shoes, as well as meat, should be better and cost less.

None knew this better than Robert Bakewell, for what he saw on his father's farm in Leicestershire and the farms around him convinced him that a little more care in the mating and breeding would work a tremendous improvement in the live stock that grazed about the land in the middle of the eighteenth century. Not until about 1760 was he able to put his theories into practice, and then the death of his father gave him the chance he sought. Setting to work to mate the finest animals he could procure, he began breeding ; and by careful selection year after year he produced an absolutely new breed of sheep, far bigger and bearing much more meat and wool

than any other breed on earth. His Leicestershire breed was a revelation to farmers, and the new sheep soon spread throughout the land and overseas. He also produced a new breed of horses, as well as a new breed of cattle. But the expenses of his experiments were so large that in spite of the big breeding fees he obtained for the use of his animals he was eventually ruined. He had the satisfaction, however, of raising for himself a magnificent monument in the Leicestershire breed of sheep, whose increased yield in his own time proved of priceless benefit to mankind. Bakewell was the first practical Eugenist, who showed that the scientific breeding of animals could achieve wonders. He died in 1795, and although few know of him or what he did, his influence is still felt everywhere.

Those who have sought to improve crops and pastures by artificial manures are numerous, and Sidney Gilchrist Thomas, the young genius who gave the world that new method for making steel, was perfectly correct in his theory that the slag which came from the furnace should prove a valuable manure. Unfortunately he did not grind it finely enough, so the Germans discovered that the secret of success was to grind the slag to powder to enable the earth to absorb its full fertilizing qualities.

The marvels achieved by using nitrate of soda on the land came as a surprise to farmers of last century, and led to the building up of a powerful industry in Chile, where the only natural beds of nitrate in the world are situated. Now the making of artificial nitrate by extracting it from the air has all but ruined the Chilean nitrate producers ; but the use of nitrate goes on, whether it is produced from the air or the nitrate grounds of Chile.

It has cost an enormous sum of money to work out the method for producing synthetic nitrate ; the most brilliant scientific intellects have been brought to bear on the subject, and the works in which the nitrogen of the air is turned into nitrate for dressing the land cost a fortune. Yet this process which has cost Man so much

time and trouble and money to bring about, and which is regarded as one of the wonders of modern science, is the ordinary commonplace job of the bacteria that dwell in most soils of the earth. These bacteria have an affinity for nitrogen, and when conditions and temperatures are right for them to work in, they take the nitrogen gas from the air and partly change its character, transforming it into nitrite which, as soon as it exists, is seized instantly by another set of bacteria which change it to nitrate. The two sets of bacteria have become such specialists that they could not possibly do each other's work ; they are doomed perpetually to help each other to bring this change about. And they store up the nitrate on the roots of such plants as peas and beans and lupins in the form of little white lumps which are termed nodules. If the roots of these plants are dug into the soil, the nodules decay and release the nitrate to feed the next crop—which is why farmers generally plough them in when the crop is gathered, and also grow fields of lupins for this specific purpose.

Clover is another plant that bears these nodules of nitrate on the root, which is why its growth is encouraged on poor pasture. Experiments in the use of fertilizers carried out in some poor downland in Sussex over a series of seasons have proved that it is scientifically possible, by the use of the right artificial manures, to turn a barren land into a rich pasture. And at Aberystwyth Professor Stapledon has been working for years to breed better grasses that will nourish a greater number of cattle to the acre than those commonly grown. He has succeeded in raising new grasses of great value that will feed three animals where only two can live to-day, and although it will be some years before any large quantities of the seeds of these new grasses are available for replenishing the present pastures, they seem destined to be the pastures of the future that will make life a little easier for all.

Nor must I forget the wonderful work of the Rothamsted Experimental Station which for ninety-six

years has been teaching the lesson of proper cultivation of the soil. Some of the experiments have lasted so long that they provide in themselves material for several books. On one plot of ground, for instance, wheat has been grown without any manure being added to the soil for fifty years in succession, and the crop, which is about half of that from manured land, remains quite constant, proving that the elements taken from the soil are being continually replaced in a natural way.

At the Great Exhibition in Hyde Park in 1851 was a sensational exhibit of grain, by Major Hallett of Brighton, whose aim was to serve humanity by revolutionizing the way in which wheat was grown. The grain shown by Hallett was specially selected from year to year. He built up his stocks by taking the best ears from the best plants grown in his fields, and the results he achieved were frankly disbelieved by most farmers.

This specially selected grain was not sown in the usual manner, but each seed was set about 12 inches apart—a very laborious business at that time. The seeds were planted in the first two or three days in September, and as they had plenty of room as well as plenty of time to grow in the autumn, they threw out many spikes, known as tillers, underground just like clumps of twitch grass. Each spike rooted itself in the soil, and instead of the usual two or three ears of corn springing up, there would be up to a hundred ears from the single grain. These ears, owing to the care with which the grain had been selected and built up, bore about twice as many grains as the average ear of corn, and it was by no means uncommon to get up to 6000 from the one grain originally planted. Hallett showed to some interested members of the British Association a plant of wheat with 94 stems, a plant of oats with 87 stems, and a plant of barley with 110 stems. Nearly thirty-five years ago Sir A. Cotton announced that by wide planting and deep cultivation he had grown wheat with an average of 55 stems to each plant, and

his yield was about 90 bushels to the acre, or roughly three times our present average yield. His announcement created a stir, especially at Rothamsted, where the highest yield obtained at that date was 56 bushels—a yield due to a very favourable season. Sir A. Cotton's results were in due time confirmed by a Frenchman who ploughed his land six times, and reaped a crop three times as large as that of his neighbours.

These old experiments of Hallett and others certainly served two good purposes. They proved that bigger yields could be got by better cultivation—modern experts say that more thorough cultivation will improve the yield by six or seven bushels an acre—and they made clear that the method of selection from varieties of wheat already in existence was *not* the way to solve the big wheat problem, for it has been proved that selected wheat, when planted out for a season or two in the ordinary way, soon degenerates until it is no better than the ordinary stock from which it was derived.

It is generally admitted that England is the finest wheat-growing country in the world. Our average yield of 31½ bushels to the acre remains unequalled by any other country. A few favoured continental farms may yield up to 40 bushels to the acre, but the average for those countries will be nothing like this, and the quantities they grow total only a fraction of the wheat grown here.

But though our yield is high, the quality of the wheat, like that of Europe generally, is poor. In Canada, where the average yield is about 17 bushels to the acre, the quality of the grain is infinitely better than that of English wheat. Little or no attention has been paid in the past to improving the quality of the wheats grown; people have been content to select the old varieties and perpetuate their faults. Actually the quality of the wheat is as important as the yield, and the only way of improving the quality is to breed new varieties.

This problem is not for the farmer—it is primarily for the scientist, the man who can create new varieties of wheat never before grown on the earth. The breeder of new wheats must be possessed of wonderful patience. He must be prepared to see countless experiments end in failure without losing heart. He must school himself to wait half a lifetime to gain what he desires. And above all, he must have knowledge coupled with the greatest skill and judgment. All these attributes, plus infinite care and a little luck, are necessary to success.

Foremost among the men who are grappling with this problem is Sir Rowland H. Biffen, whose work in breeding new wheats at Cambridge has been recognized by a knighthood and the award of the Gold Medal of the Royal Society. And probably nearly all the daily bread of future generations will be made from wheat which he has brought into being.

At Cambridge the amazing sight may be seen of wheat being grown in giant cages made of small-mesh wire, in order to keep the birds away from the grain. These cages are used for comparative yield trials, the land being divided like a chessboard into squares of four feet. Generally four varieties of wheat are sown, so arranged that each variety is grown in about fifty different places, to allow of any variation in the soil.

Wheats from all parts of the world are collected and used for breeding purposes, but in every case a variety called Red Fife is made to serve as the mother plant. This wheat is of fine quality, hard in the grain, and it ripens well; moreover, it may be grown for year after year without losing quality, whereas all other foreign wheats deteriorate after being grown a season or two in England. Having a low yield of high quality, Red Fife is cross-fertilized with a wheat having a high yield of a poorer quality, with the result that among the offspring will be one or two with the best qualities of both parents. Occasionally a wheat is produced with a higher yield than the high-yielding parent, and this is the wheat most sought after by the scientist. In due

GROWING WHEAT IN CAGES ON THE EXPERIMENTAL FARM OF THE CAMBRIDGE SCHOOL OF AGRICULTURE. IT IS HERE THAT SIR ROWLAND BIFFEN, F.R.S., THE HEAD OF THE SCHOOL, HAS BRED NEW WHEATS, SUCH AS "YEOMAN," WHICH SURPASS IN YIELD AND OTHER QUALITIES ALL THE OLDER TYPES OF WHEATS

course the grain is gathered and labelled, and the next season the eighty or so plants from the ear will be found very much alike in character. When this grain is planted in its turn, big variations begin to appear. The finest ears are selected and the rest thrown away, and by the third or fourth generation the type becomes fixed and breeds true. Then comes the task of growing the wheat for seed, which is saved and planted again and again until stocks are ready for one or two favoured farmers. But for years the grain is of course much too valuable to be destroyed by eating it.

It is nearly a quarter of a century since Sir R. H. Biffen bred one of the finest wheats in the world, which was duly called Yeoman. Ever since it has been more and more widely cultivated, but even so there is not enough seed available to satisfy all the farmers. By ordinary methods of cultivation Yeoman has yielded 96 bushels to the acre, and from five acres previously used by a Mr. Amos for growing hops, over 480 bushels of wheat was harvested !

This is by no means the best that has been achieved, for when I went to Cambridge to investigate the matter, Sir R. H. Biffen showed me a better wheat. It had perhaps a dozen stalks about four feet in height, the straw was strong and the ears, from three to three and a quarter inches long, were packed tight with grain. It will be some years yet, however, before the ordinary farmer will be able to plant this remarkable wheat in his fields.

Unfortunately, wheat is very prone to diseases, which claim about one-tenth of the world's harvests. It is a big toll for the farmers to pay every year, and the worst of the diseases is known as rust. Practically every wheat is a prey to it, and the possibility of breeding an immune variety has long occupied the thoughts of the wheat breeder. This seeming impossibility has now been accomplished, for good luck combined with keen observation have enabled Sir R. H. Biffen to conquer rust. When half a bushel of Duluth wheat from the

neighbourhood of the Canadian Great Lakes was planted at Cambridge, the whole plot showed red with rust. It was a sad sight. The average man would have torn up the plants and burned them. But Professor Biffen, in going carefully over the plot, noticed two plants that were green where the others were red. They were like two oases in a desert. These were marked, but instead of the plants from the seed remaining green like their parents, not a single plant was free of the disease. Only a scientist familiar with the Mendelian law of heredity would have continued the experiment further ; anyone else would have thrown the plants on the rubbish heap. In no wise cast down, the scientist planted all the seed that came from the diseased plants, and he had the glory of seeing one plant in four grow free of rust. The plants grown from the seed of these immune plants have remained immune ever since. The one drawback is that they give a smaller yield than Yeoman or the new unnamed variety, but, judging by what has already been done, this drawback will one day be overcome and a rust-resisting wheat giving a very high yield will be an accomplished fact.

That first experimental farm in the world which Sir John Lawes set up at Rothamsted in 1834 has helped to revolutionize agriculture, while in the creation of new grasses and new wheats, not to mention improved vegetables of various kinds, British scientists and horticulturists have proved to be without peer. But of the men who have toiled so diligently to increase the yields of field and farmyard, none has accomplished more than Professor Sir Rowland Biffen, whose wonderful new wheats will benefit all posterity.

As Sir Humphry Davy wrote over a century ago : " Discoveries made in the cultivation of the earth are not merely for the time and country in which they are developed, but they may be considered as extending to future ages and as ultimately tending to benefit the whole of the human race."

CHAPTER XV

MEN AND MONKEYS

DAY by day the boundaries of knowledge are being widened, and many views which shocked and enraged people a little more than half a century ago are already regarded as being hopelessly out of date. We move with the times, and it is difficult for us to realize how the people of a previous generation were penned in by the strongest possible walls of ignorance and prejudice, beyond which the great majority had no desire even to peep. That Adam was the first man they firmly believed, and that the Garden of Eden was his original home they had no doubt. They and their fathers and grandfathers had always been taught that this was so, and so strong a hold had this teaching on the Western peoples that they, with the exception of the smallest possible minority, found it almost impossible to believe anything else.

In 1797, however, Mr. John Frere found some strange stones at Hoxne, and the more he examined them the more certain he was that they had been shaped by human hands. These flints, he felt sure, were worked by men who did not know the use of metals—a race of men who came before the time of Adam. Means of communication in Frere's days were very bad, and his ideas were not widespread. Those who heard of them, however, mainly regarded burning at the stake as too kindly a death for such a heretic. The majority, knowing nothing about him or his ideas, carried on their lives as ordained. Among the working classes of the country, the larger proportion a century ago could not read or write, and they just believed what they were told.

A little evidence here, a scrap there, began to throw considerable doubt upon the teachings of the past. And when that logical French doctor, Boucher de Perthes, found in the sandpits of the Somme valley a number of flint implements that were undoubtedly the work of men, and found them so deep down in strata that had lain undisturbed since the river had deposited the banks of gravel ages and ages before, since when it had gradually during thousands of years cut a deeper channel and left the sandbanks high and dry up the sides of the valley, then the Frenchman realized that these men must have lived in very remote times indeed. Not until he had collected indisputable evidence did he sit down and write his book about antediluvian man, which was published in 1847.

Like John Frere he met with an unpopular reception. All the slings and arrows of unintelligent antagonists were concentrated on the open-minded French scientist. Mostly, however, he was regarded as a harmless sort of lunatic who had made a hobby of gathering stones and then talking and writing the most arrant nonsense about them. The opposition of his own people in no wise deterred him ; it merely made him the more determined to prove his case. He knew he was right and the world was wrong—but it often takes more than one man to move a mountain of prejudice. And the discoveries of Boucher de Perthes were like to be buried as deeply as the stones he had unearthed, and forgotten like the ancient men of whom he had written.

Then down the Somme valley an English doctor named Falconer wandered one day and saw what the Frenchman had discovered. It was to him a mighty revelation which he knew must have far-reaching effects, and on his arrival in England he sought out two of our greatest geologists, who were later known to fame as Sir Joseph Prestwich and Sir John Evans, and told them what was being discovered on the banks of the Somme. They journeyed to France, and with their own hands found and removed some of the ancient imple-

ments. Then they threw their whole weight on the side of scientific truth, and what the Frenchman could not do alone they, with their big influence, helped him to accomplish. Sir Charles Lyell wrote a book on the subject, Huxley dealt out hammer-blows of truth at the opposition, and the walls of prejudice began to crumble.

Evidence was accumulating all round, in too many countries and by too many different men, to prevent the truth from being realized very much longer. But it is good to know that Englishmen fought strongly so that truth might prevail in days when it was easier to deny the truth and more comfortable to agree with public opinion. The remarkable thing is that Prestwich for the greater part of his life carried on business as a wine merchant, and yet found time to make striking discoveries that have an important place in the scientific life of the British nation.

The finding of an unusual type of skull in a cave at Neanderthal, in Germany, in 1856, gave scientific men a good deal to wrangle over, for it was obviously the skull of a brutal type of man, with great bony ridges above the eyes, rather akin to the gorilla. And the unearthing of a still more unusual type of skull in Java of a creature of small brain capacity, who yet obviously walked erect, excited further interest in 1897.

But these finds, useful as they were for punching home the facts that Man existed on the earth long before the Flood and the Garden of Eden, were of less account than the discovery of the Piltdown skull in Kent by Mr. Charles Dawson, in 1912, just before the war. Mr. Dawson is a solicitor by profession, and a palæontologist by nature. The study of the past, as revealed by fossil bones, is to him an absorbing hobby. And certainly no professional scientist has made more striking finds than this amateur who, wandering over his beloved Sussex, has found many relics of the monsters of the past, including three new varieties of iguanodon.

A man who goes about paying money for bones and stones soon gains a reputation among the workmen of a

district, and if anything unusual turns up under the spade or pick they set it aside until he comes along, in the hope that it may interest him and draw a coin from his pocket. In the case of the Piltdown skull, Dawson was tramping over the common when he found men digging out gravel. Stopping to chat with them and inquire if they had found anything—the natural thing for him to do—one of them produced a bit of a skull which they had dug out and cast aside a little earlier. But it was weeks before two other bits were uncovered, to reveal that this was probably the most remarkable discovery that had been made up to the moment.

As all the flood-water from around drained into the gravel pit, Dawson was obliged to wait patiently until finer weather came and the pond had percolated away. Then followed several months of hard work, and the rest of the skull with part of the jawbone were finally turned up. There were the bones of elephants, hippopotami, and other animals found in conjunction, and the searchers learned that long ages ago the river Ouse ran by this spot and carefully buried away all these relics for the benefit of posterity, and that something had made the river change its course to its present site, where it had cut a channel eighty feet deeper than the old channel that used to carry its waters to the sea !

How long was that ago ? Science guesses, but nobody really knows. The skull proved to be that of a woman with the smallest brain capacity known—not much larger than that of a chimpanzee—and the great anthropologist, Professor G. Elliot Smith, says that the formation of the jaw indicates that this woman had not yet learned to speak. It must have been the ideal age for husbands ! Woman, apparently, has since made up for lost time !

Quite recently a skull at Taungs, in Africa, has been cut out of the rock and has caused no little excitement among specialists, while the very latest discovery in China, the skull of the Peking man, provides the strongest proof that the African ape and man are very closely related.

These assumptions are accepted now as a matter of course without so much as the lift of an eyebrow. Sixty or seventy years ago they caused the greatest outcry ever known, and aroused such strong feeling that families quarrelled bitterly over them, and more than one logical young man left home as a result of the bad feelings his extreme views had created.

It was in 1859, the same year that Prestwich and Evans went to the Somme and satisfied themselves about the antiquity of man, that Charles Darwin published his *Origin of Species*. This kindly, simple man with the mind of a genius was like a modern Joshua. He blew a blast on his trumpet, and the walls of Ignorance in which people had been confined since the beginning of Time fell down flat. But people still refused to walk over the ruins into the wide fields of Knowledge which Darwin opened up. Instead they simply herded closer together and vituperated Darwin for prying into secrets which were considered no concern of Man's. To suggest that all living things were not created in seven days in the form in which we now find them, but were gradually evolved after many changes and variations over long ages of time, was considered to be rank blasphemy. It seemed to contradict the Holy Bible.

Yet Darwin himself was the son of a clergyman, who was born at Shrewsbury on February 12, 1809, and spent his whole life in seeking knowledge and truth without the slightest idea of personal gain. A man more honourable or less inclined to hurt the feelings of his fellows it would be difficult to find. But those who were staggered at the idea of a natural selection which shapes our ends were not concerned with Darwin's innate gentleness or courtesy. To them he was anathema, and they attacked him with any metaphorical stick or stone that came handy. He was not the sort of man to defend himself, but luckily Professor Huxley became Darwin's defender, and the attackers found a champion before whom they eventually went down like ninepins.

When Darwin issued his *Descent of Man*, people regarded it as a personal affront to humanity. They imagined he had asserted that Man was descended from Monkey. It was the most popular of misconceptions. Prim and proper people who prided themselves on their families and ancestry became flaringly indignant at the idea of a monkey being at the head of their long line of ancestors! The controversy was carried on everywhere; the talk ceased only when slumber closed the eyes and stopped the tongue. Most of those who took the trouble to read Darwin understood his contention that somewhere in the dim past Man and Monkey arose from a common source, which had formed two branches, one of which developed into man and the other into monkey—which is a very different thing from saying that Man was descended from a monkey. However, in the end truth prevailed; the staunchest opponents died out, a younger generation with more flexible minds and less rigid ideas absorbed Darwin's teaching, and the flickering candle which lighted the field of knowledge during his life flamed up into a mighty beacon which illuminated the whole world and every living thing in the heavens above, on the earth below, and in the moving waters of the earth.

In the main, to-day Darwin's theory of natural selection and the survival of the fittest remains unshaken, although it has been necessary to subject it to modifications here and there. But no one could examine some of the afore-mentioned skulls side by side without being struck by the way the human head has developed.

A few years ago I paid a visit to some caverns just over the Italian border near Mentone in order to examine the prehistoric skeletons discovered there. After I had made my examination at Les Rochers Rouge I went outside and decided to climb up into the field beside the railway which runs through to Ventimiglia. In the soft earth as I climbed I found many prehistoric remains—teeth and fragments of human bones, which I dug out of their places and took along with me. In due course

they went into my suit-cases, and the faces of the customs officers as they saw this collection were most amusing to watch, but what delighted me more than anything was to hear them referred to later as " a lot of old bones and stones " !

Probably no other book ever published has worked such a revolution in thought as Darwin's *Origin of Species*. It knocked off the shackles of the past and emancipated the mind of man. It gave mankind a totally new conception of life, abolishing the narrow view which was considered orthodox and giving a view so vast that the clearest vision cannot take it all in. The astounding coincidence is that the same theory should have been reached independently by two different men, for Alfred Russel Wallace wrote a paper on the same subject about the same time. The idea occurred to Darwin during his voyage in the *Beagle* to South America, and he started collecting his facts in 1837, and not until he had collected material for five years did he draw up some short notes. In 1859 this epoch-making book was published, twenty-two years after he had started to collect his facts. In his introduction he writes: " My work is now nearly finished; but it will take two or three more years to complete it, and as my health is far from strong, I have been urged to publish this Abstract. I have more especially been induced to do this, as Mr. Wallace, who is now studying the natural history of the Malay Archipelago, has arrived at almost exactly the same general conclusions that I have on the origin of species. Last year he sent me a memoir on this subject, with a request that I would forward it to Sir Charles Lyell, who sent it to the Linnean Society, and it is published in the third volume of the journal of that society. Sir C. Lyell and Dr. Hooker, who both knew of my work—the latter having read my sketch of 1844—honoured me by thinking it advisable to publish, with Mr. Wallace's excellent memoir, some brief extracts from my manuscript."

That gives the measure of Darwin the man. A

memoir by another man on a subject on which he has been working half his life comes into his hands, and without hesitation he duly makes arrangements for its publication. And when he is pressed to publish parts of his own work—after considering whether it would be dishonourable of him to do so—the first thing he does in his introduction is to pay a tribute to the work of Alfred Russel Wallace, who also had the genius to read the same riddle of Nature at the same time.

Many men have written books before and since, but none has had such a profound effect upon the thought of his own generation and the generations that were to follow after. This studious scientist who spent a lifetime studying the lowliest of creatures is one of the greatest glories England has ever produced: in his sphere no other man in the world has done so much to open the eyes of mankind to the mysteries and miracles of all existing forms of life.

CHAPTER XVI

THIS WAY TO THE BRITISH EMPIRE

SPAIN, Portugal, France, and Holland all sought Empire overseas before the British Empire was born, and all, sooner or later, failed in their ambitions. The reasons why they failed may be found, at great length, in many learned books, but I would sum them up in a few words by saying that they failed because they had not the British flair for colonizing nor the British sense of justice and fair-play.

We have heard a great deal about the rights of minorities since the close of the World War of 1914–18, but that is a lesson of which other nations are hardly competent to repeat the alphabet, while Britain has already passed her examination with high honours. I will go much farther and assert that if the great nations of the past had been more cognizant of the rights of minorities, there would be no British Empire to-day, for Spain or France would have ruled those vast tracts of territory abroad which, under the dominion of Britain, now rule themselves.

There has been so much talk on the Continent about perfidious Albion that the nations have come to believe it true. In the continental peoples an ingrained mental trickery compels them to stoop to all sorts of subterfuges in order to get the best of a bargain or to leave themselves some loophole by which they can repudiate it altogether. It would be as fatuous of me to suggest that we have all the virtues as it is ridiculous of our critics at home and abroad to assert that we have all the vices, but I am patriotic enough to believe that on the whole the British have some qualities that other

peoples lack, and one of these is the determination, once they have given their word, to keep it. There are exceptions, of course, but they merely emphasize the rule.

I wonder if the Right Honourable Philip Snowden, the Chancellor of the Exchequer, when he was presenting his Budget in April 1930, recollected the man whose originality and foresight were responsible for providing so many millions of pounds sterling for the revenue of the country every year. The Chancellor commented on the growth of the habit of smoking among girls and women, but I will wager he gave not one thought to the man who first puffed the pipe of peace in this country. And of the millions who ask for a packet of Virginia cigarettes each day, how many realize that Sir Walter Raleigh was the founder of Virginia, whence the tobacco derives its name ?

The cloak that Raleigh spread for Queen Elizabeth to walk upon eventually covered a multitude of sins, as well as quagmires of political mud, but the handsome man who became the lover of the greatest queen England ever had, was himself one of the greatest of men. Fed on romance from his boyhood, adventure was in his very veins ; and the man who lived to hold his queen in his arms and press his kisses on her lips can claim to have lived a romantic life indeed. Even queens have their human moments and are moved by the same passions and desires that stir at some time in most breasts. But their wrath is apt to fall heavily on those they favour if there should be any defection, and when Elizabeth discovered Raleigh's intrigue with one of her maids of honour, she simply clapped them both in the Tower. For four years he cooled his heels there, but not his ardour, and when he married Miss Throgmorton it must have been a bitter pill for Elizabeth, although that lady herself possessed a roving fancy.

Raleigh, as bold a buccaneer as Drake, provided not only the money to equip some of Drake's little affrays, but also the sum that was needed to colonize Virginia. Rightly he is the Father of the British Empire, and

Queen Elizabeth its Mother, for she herself named the colony which to-day, under the American flag, coaxes so much money out of our pockets to send it up in smoke. There is not enough water in the world to put out the fire that Raleigh lit when he started the smoking habit, although his Irish servant thought there was enough water in the bucket he carried to quench the fire which he concluded was consuming his master. Imagine the surprise of the man, the greater surprise of the master, as the water drenched him—one of the most delightful jokes in all history ! And when Raleigh brought those strange tubers from the new colony and some were cultivated in what is now the Strand, he ensured the Old World against famine by providing it with the easily grown potato.

A great figure, a fearless fighter on land and sea, a fine scholar, a brilliant speaker, an impassioned lover, Raleigh's doom was really sealed when Elizabeth died. All that Elizabeth had given him James the First seized. Condemned to death on a false charge of conspiracy, Raleigh was imprisoned for fourteen years, whiling away the time writing a *History of the World* for Prince Henry, who was a great favourite of the fallen courtier, and used to visit him frequently in the Tower. For a time the prison gates opened to let him forth on his last expedition, then James rang down the curtain with one of the cruellest murders in history. Urged to face the East by a religious friend, Raleigh as he knelt at the block murmured, while the headsman with his deadly axe stood over him : " What matter how the head lie, if the heart be right ! "

A fine philosophy of life to fall from the dying lips of the gallant Englishman who founded our Empire ! If the folly of a later generation lost us what he gained, and George the Third by his headstrong actions gave the first indication of his approaching madness, that is no reflection on Raleigh's ideal, but merely a perpetual example of the harm that may arise when a people labour under a sense of injustice.

The narrow margin of two days by which we forestalled the French in occupying and starting to colonize Australia has been referred to in another chapter ; and when we consider that the first colonists were convicts, and that their original settlement has developed into the Sydney of to-day, it is extraordinary what has been accomplished in less than a century and a half. Governor Phillips, who took out this human flotsam from the English gaols, had a formidable and heartbreaking task to find a bare existence for those under his charge. Outbreaks among the convicts were perhaps to be expected, but the disaffection among his troops was an even greater source of anxiety. One of the main troubles was the non-appearance of supply ships which were relied upon to carry the essentials for founding this new civilization, but eventually these would turn up and the trouble would be smoothed away. Had those who advocated this scheme for colonizing Australia not possessed enough common sense to know that the new colony could not possibly be self-supporting from the very beginning, and had they not sent out supplies to help the colonists until they were able to help themselves, our colonizing attempt would probably have failed.

If we beat the French in the race for Australia, the French were first in the field in Canada, quicker to waken to the possibilities of that northern land, quicker still to settle in those provinces which they called New France. And when war came between France and England, the bands of troops, irregular and otherwise, gathered to overthrow Montcalm were overthrown instead. It was perhaps one of the wisest moves in history to send that expedition under General Wolfe to Quebec, but it was asking him to do the impossible to storm those inaccessible heights of Abraham and take the city in the face of Montcalm's fortifications and troops. How he fretted and fumed for weeks on the island in the St. Lawrence opposite Quebec, how Gray's *Elegy* appealed to him so much that he would rather have written that poem than win the greatest victory, how he

SOME OF THE BEAUTY OF ENGLAND CAPTURED BY A LENS AT NEWLYN IN CORNWALL WHEN THE FISHERS WERE COMING HOME AT DAWN. THESE TINY HARBOURS SCATTERED ROUND OUR COASTS HAVE SIRED MANY A MAKER OF EMPIRE AND THE SEAS OUTSIDE HAVE GIVEN HIM EXPERIENCE THAT HAS ENABLED HIM TO OVERCOME THE GREATEST HAZARDS AND TAKE HIS CRAZY LITTLE SHIP IN SAFETY ROUND THE WORLD

detected up-river a lightly guarded path to the cliff-top, and took his men up just before dawn, and in half an hour won Canada for Britain and lost his own life, are incidents known to everyone.

The queer thing about it is that Quebec was French then, and it is predominatingly French to-day. French or English is the legal language of the province, and the people retain their own religion, local laws, and customs. They have, in short, been allowed to go on in their own sweet way and rule themselves. Naturally it would be ridiculous not to expect some racial prejudices, but Quebec is proud of its power in Canada to-day, and is happy under the British flag.

In giving Canada her own Constitution in 1791, Pitt laid the foundations of Britain's greatness when the world was still rejoicing at the terrible blow dealt to our prestige nine years previously by the loss of our territories which proclaimed themselves the United States. And Fox, in his wisdom, remarked : " I am convinced that the only method of retaining distant colonies with advantage is to enable them to govern themselves."

One of the truly great things about the English is their ability to smooth out racial differences. As a rule, we live and let live, and if we happen to settle among peoples who have their own particular customs and religions, we respect these as being the private affairs of the people concerned, and do not seek to suppress them or interfere with them, providing there is nothing inhuman or cruel about them, and providing that the new order of things is obeyed in those respects which are essential to carrying on a form of government.

In this respect India is one of the greatest miracles that Britain has ever performed. Here again the French were the first to dominate the country. Indeed, the French Governor, Dupleix, deliberately planned, by training Indian soldiers and staffing them with French officers, to turn out the British and make India a French dependency.

Considering all the diatribes that are being launched

against Britain at the moment by the revolutionaries in India and their sympathizers at home and abroad, it cannot be too widely known that Britain did not go to India to conquer, but merely to trade. The sole motive actuating the British East India Company in setting up its posts at Madras and elsewhere was to make profits by importing and exporting Indian merchandise. The continental nations are pleased to call us a nation of shopkeepers, and of a verity we went to India as a nation of shopkeepers and not as soldiers and Empire builders.

When Dupleix fell on Madras and captured that British trading post in the middle of the eighteenth century, India was in a chaotic state, practically falling to pieces, with state against state, one ruler either fighting openly against another or plotting in secret. Dupleix, seizing his opportunity, lent his help wherever he saw that he could govern through the native ruler. And if Dupleix had been properly backed by France, that country might have held India for a number of years. Personally, I do not think that France could have retained control in India to this day, because the French lack the colonizing genius which we possess, and they would probably have committed some indiscretions, leading to a general uprising that would have overwhelmed them.

Instead of being compelled to withdraw in the latter days, however, they were destined to be thrown out in the beginning, and the genius who accomplished the feat and added India to the British Empire was Lord Clive. As a boy, Clive was completely misunderstood, quite out of sympathy with his people, who considered him so incorrigible that they were glad to ship him off to India when he was but seventeen, as a clerk to the East India Company. Clive had his faults, but he loved England, and his strange retiring nature so handicapped him in that romantic land that for months he did not speak to a soul outside the office. Life became so unbearable that he tried to shoot himself with a pistol. Twice he pressed the trigger, and twice the

pistol refused to go off. Assuring himself that the pistol was in perfect working order, he concluded that he was destined for something great, and refrained—on that occasion—from pressing the trigger a third time.

Clive may have been an indifferent clerk, but he was a born soldier. And when he saw Dupleix in all his arrogance ruling thirty millions of natives, and taking what he listed from the coffers of the rulers, while the natives themselves regarded the English with scorn, the clerk was not disposed to accept the situation without striking a blow for England. The capture of Madras by the French had started Clive on his army career. Four years later, when the French and their native allies were besieging Trichinopoly, Clive sensed that the fall of that place would be the doom of Britain in India. As the officer commanding at Madras was home on leave, there was no officer to take charge of the tiny British force available. Going to his superiors, Clive urged them to let him attack the capital of Arcot to draw off the enemy from Trichinopoly, and got his way.

He had never commanded before. Under him were only two officers who had been in action, while of the other six, four were clerks straight from the office. Two hundred English troops and three hundred natives made up the entire force. It seems the craziest expedition ever undertaken. But the fates were more than kind. Under shelter of a storm, Clive scared the enemy from the fort at Arcot without firing a shot, and the next night he stole out with his little force and fell on the 3000 men encamped ready to attack him, and slaughtered so many that the rest fled. When he re-entered the fort he had not lost a single man !

As Clive foresaw, this brought the French and their allies hastening to Arcot, and for fifty days he was besieged in the fort. Every day he laid a stronger hold on the affection of his native troops, who so worshipped him that they begged the whites to take all the grain and just give them the rice water to live on—a thing to which he would not consent. They were fighting

together, and they would all suffer the same hardships and dangers. Eventually the besiegers were driven off with great losses, and Clive, with his forces augmented, began to smash the power of the French. He performed valorous deeds with his men ; the more he did the more his fame grew among the natives, until his very name came to be feared.

After a holiday in England, due to ill-health, Clive went back to consolidate the British position. The foul tragedy of the Black Hole of Calcutta, in which 146 Europeans were locked up in a tiny cell twenty feet square overnight, and only twenty-three crawled out alive in the morning, sent him hastening to wreak vengeance on the Nabob responsible. Calcutta was soon regained, and in the face of Clive's onslaughts, the Nabob made overtures for a truce. In the end, after Clive for the first and only time degraded his honour by countering Oriental trickery with trickery, he defeated the enemy at Plassey. Attacking an army of 60,000, he, with his small force of only 900 Europeans and 1500 natives, utterly routed the foe. It was, like most of Clive's victories, overwhelming.

That was the end of French power. Money and treasure were showered on Clive, and in later years he was impeached by the House of Commons for taking these gifts. But it was the usual thing in his day, and when questioned about it he answered : " My God, Mr. Chairman, when I consider all the circumstances, I am surprised at my own moderation ! "

Led into the treasury of a native ruler, he was told that anything he asked would be given him. He accepted £200,000, but if he had asked for £1,000,000 he would have got it. Few men would have made their demands so small.

Before appearing at the bar of the House of Commons, however, Clive returned to India as Governor-General to clean up all the bribery and corruption that was going on. He attacked this task as relentlessly as he attacked the enemy in the field. When he left India

the bad old system was swept away, and in its place was instituted a system under which the officers of the Company received a salary on which they could live without taking bribes from the natives and trading for themselves. Which is as it should be.

People have railed against Clive, and asserted that he took bribes himself. But, as previously mentioned, he merely did what everybody else did at that time; he made no attempt to hide it and could see no wrong in it. Regarding his lapse into Oriental trickery, his opinion was that he did nothing of which he need be ashamed, that in dealing with unscrupulous people you cannot be too scrupulous, and that in a good cause, any means will justify the end. So far as this incident is concerned, he may be considered in two lights—as a forger and trickster, or as a noble-hearted man who was forced to sully his honour for the sake of his country. Anyway, he felt keenly the attacks that were made on him, and in the end found peace by again pressing the trigger of a pistol. This time the bullet found its mark —a sad end to a brilliant man who did much good for Britain and still more good for India.

Macaulay has opinions on the subject that are worth recording here: "That honesty is the best policy is a maxim which we firmly believe to be generally correct, even with respect to the temporal interests of individuals; but, with respect to societies, the rule is subject to still fewer exceptions, and that for this reason, that the life of societies is longer than the life of individuals. It is possible to mention men who have owed great worldly prosperity to breaches of private faith. But we doubt whether it be possible to mention a state which on the whole has been a gainer by the breach of public faith. The entire history of the British in India is an illustration of the great truth, that it is not prudent to oppose perfidy with perfidy, and that the most efficient weapon with which men can encounter falsehood is truth. During a long course of years, the English rulers of India, surrounded by allies and enemies whom no engagement

could bind, have generally acted with sincerity and uprightness ; and the event has proved that sincerity and uprightness are wisdom. English valour and English intelligence have done less to extend and to preserve our Oriental empire than English veracity. All that we could have gained by imitating the doublings, the evasions, the fictions, the perjuries which have been employed against us, is as nothing when compared with what we have gained by being the one power in India on whose word reliance can be placed. No oath which superstition can devise, no hostage however precious, inspires a hundredth part of the confidence which is produced by the 'yea, yea,' and 'nay, nay' of a British envoy. No fastness, however strong by art and nature, gives to its inmates a security like that enjoyed by the chief who, passing through the territory of powerful and deadly enemies, is armed with the British guarantee. The mightiest princes of the East can scarcely, by the offer of enormous usury, draw forth any portions of the wealth which is concealed under the hearths of their subjects. The British Government offers little more than 4 per cent. ; and avarice hastens to bring forth tens of millions of rupees from its most secret repositories. A hostile monarch may promise mountains of gold to our sepoys, on condition that they will desert the standard of the Company. The Company promises only a moderate pension after a long service. But every sepoy knows the promise of the Company will be kept ; he knows that if he lives a hundred years his rice and salt are as secure as the salary of the Governor-General ; and he knows that there is not another state in India which would not, in spite of the most solemn vows, leave him to die of hunger in a ditch as soon as he had ceased to be useful. The greatest advantage which a government can possess is to be the one trustworthy government in the midst of governments which nobody can trust. This advantage we enjoy in Asia."

These remarks are as applicable to-day as they were

ninety years ago when they were published. It is extraordinary how young men of twenty or thereabouts, trained in the tradition of the English public school, going out to India without any experience at all, have ruled provinces as though born and bred to the purple. And the natives, seething round the feet of the British Raj, lying, stealing, cheating, and murdering their own kind, have been able to look up to the Englishman and know that he cannot be bought, but that he will mete out even-handed justice to all. The white men of the Indian Civil Service who have given their lives and talents to India have done noble work; they have welded into an empire many states, composed of antagonistic peoples, of many different castes and sects and creeds, who, but for the restraining hand of the English whites, would be flying at each other's throats. It is a miracle unsurpassed upon this earth, and no other race but the British has ever accomplished it. The only thing approaching it is the marvellous way that Lawrence went out from Cambridge straight to Arabia during the war and welded the tribes, many of whom were the deadliest enemies, into a fighting force under his own command. Lawrence's word they could and did trust, but they could not trust each other.

It happens that I am personally acquainted with Nehru, whose arrest in India after Gandhi had defied the salt laws precipitated the outbreaks of April 1930, and led to a number of murders of Europeans. We met several times in Switzerland, and I had a chat or two with him, but he was then very circumspect and said nothing to which anyone could possibly take exception. A slight, well-educated, quiet man, very courteous and with a pleasant but very fleeting smile, he was naturally reserved with me. A more harmless individual it would apparently be difficult to find, but a foreign friend of mine to whom he used to chat much more freely told me, one day, that Nehru did not like England, and that he held revolutionary ideas that were antagonistic to Britain. I certainly saw no indication of it, and to me

he was one of the gentlest, most law-abiding men it would be possible to find. As I was English, I presume he thought it prudent not to air his extreme views in my presence.

India is demanding home rule, but are the Indians fitted to rule themselves ? From friends living in that country I gather that the majority of Indians really prefer to let things remain as they are ; they are afraid that if Britain hands the reins of government over to Indians, those who gain power will oppress their opponents and the weaker sects, and eventually cause trouble that will bring the country to the chaos out of which Britain lifted our Indian Empire. Gandhi himself says that if the Hindus attain independence and fail to placate the Mussulmans and other minorities, " there must inevitably be civil war."

To imagine that because the country runs tolerably well under British rule it will run as well under Indian rule may be very wide of the mark ; as wide, in fact, as to imagine that all those hostile tribes in Arabia would have obeyed the commands of an Arab. No Arab could ever have welded them as Lawrence did ; he was someone aloof to whom they could look up, someone above their tribal differences, outside their racial hatreds, who would hold the balance level between them. Is not this the reason why Britain has been able to compose in a broad sense all the differences of the Indians and enable them to work in comparative harmony ?

After the foregoing was written, Lord Rothermere published in the *Daily Mail*, under the title of " What India means to Us," an article from which I quote the conclusion :

" What the Indian agitators want is to force us to hand over India to the tyranny of the Hindu oligarchy, which would be the most jealously exclusive and the most shamelessly corrupt the world has ever seen. This would not bring peace to India—only oppression, extortion, civil war, slavery, famine, epidemics of disease, and, in the end, foreign invasion.

"We cannot turn our backs upon our duty and compound with the open enemies of Britain. *To do so would be such a cowardly betrayal of a great trust as would blacken our nation's name for ever.*

"BRITISH RULE IN INDIA IS IRREPLACEABLE. OUR DUTY THERE IS NOT TO ARGUE WITH BASE AGITATORS BUT TO GOVERN."

The Indian problem is far more complex than is generally realized, and it will not be solved by outbreaks which aim at the disruption of all government. In a debate on the question in the House of Commons the Right Hon. Wedgwood Benn, Secretary of State for India, said: "The Government machine to-day, although it is true it was designed by English hands, is mainly operated by Indian hands."

Obviously Indians are already playing a part in governing themselves, and in due course, when they have served that apprenticeship which is even more necessary in statesmanship than in any other form of business or art, and have proved themselves worthy, they may play a bigger part yet. But India itself can only be saved from its own passions and hatreds by British rule.

What we have done in India, we have done also in Egypt. When we went to Egypt there was absolute chaos, the country was bankrupt and rent with dissension. The administrative genius of Cromer made Egypt a country fit for the Egyptians to live in: the Egyptians themselves had failed to accomplish this. Under British guidance the financial affairs of Egypt have been straightened out; the beneficent waters of the Nile have been properly harnessed, the cotton and other industries have been developed, hundreds of thousands of acres of new land have been irrigated and made fertile, while the natives themselves have dwelt in security under the British suzerainty. It remains to be seen whether the Egyptians can do as much for themselves as Britain has done for them in the past.

As for the Soudan, strife and misery have been

replaced by peace and prosperity since Britain directed that country, and the Soudanese look forward to the same tranquil and prosperous conditions so long as their affairs are in British hands. They are terrified that Britain may be induced to relax her hold and allow the Egyptians to filter into Soudanese administrative posts, in which case the Soudanese know that they will be oppressed until they will be driven to revolt, as in the past.

Why, after all, should Britain trouble to lift such countries out of their squalid misery and make life bearable for them? Britain gains nothing by it. These countries make no direct contribution to our revenue; it is not as though they were paying us £50,000,000 or £100,000,000 a year for taking their burdens from them. In an indirect way, of course, we gain revenue from the profits made by our trade with these countries; but we have frequently had to spend large sums in straightening out their affairs and fitting out punitive expeditions. Yet all nations have the same rights to trade in these countries as the British: we help these countries out of their troubles and set them on their feet, but we do not expect, nor do we claim, more favourable trading conditions than those accorded to other nations. What other country would act so impartially? These are the facts to bear in mind when the babblers who belittle Britain air their hostile views.

Perhaps the most interesting study of all in the colonizing methods adopted by the British is that of South Africa. The Dutch East India Company founded Cape Colony in 1652, and for nearly a century and a half they farmed and traded in peace. I must pay tribute to the Dutch for their ability to colonize. They have qualities akin to our own for settling in a virgin land and forcing it to yield them sustenance; they wrestle with nature, with the jungle and the forest, in the same determined manner until they bring the land under cultivation. Of all the other races, the Dutch most nearly approach the genius of the British in these

respects. The Dutch are good, but the British are better—which is why the British Empire exists.

Two attempts by Britain to gain a foothold at the Cape, which was an important point on the road to India before the Suez Canal came into being, were frustrated. Then the Prince of Orange was deposed while the French revolutionaries were turning the Netherlands into a republic, and rather than see France seize the Cape, he made a present of it to Britain. Unable to hold it, he probably decided that it was better to give it away to his friends than allow it to fall into the hands of his foes. Thus our original occupation of the Cape was comparatively clean and unsullied, in spite of the piratical intentions manifested some years earlier. Gratefully accepting the generous gift, Britain sent a squadron out to occupy it and hoist the Union Jack.

The Peace of Amiens in 1802 settled many differences, and we magnanimously restored Cape Colony to the Dutch—a tactical blunder of the first importance. They ruled at the Cape for about three years more, when English statesmen sought to retrieve their own blunder by re-occupying it—which they did.

After we had smashed the power of Napoleon, the question of the ownership of the Cape was again discussed with the Dutch, and at a cost of £6,000,000, paid out of the pockets of the British tax-payers, Cape Colony was formally ceded to Britain. As Britain was first presented with the colony and then bought and paid for it, our legal title may be considered as doubly clear, and our foothold at the Cape a little more honourably obtained than may be said of some of our other outposts of empire.

The Dutch settlers there asked nothing but to be left alone, yet many girded at the British yoke. Our Anti-Slavery Acts started the unrest in South Africa. All the Dutch settlers were working their farms by slave labour, and Britain allocated to the Cape as compensation for freeing the slaves only £1,250,000,

whereas the Dutch considered their slaves worth £3,000,000. The vital spot of most nations is not the heart, but the pocket; the majority of people will be humanitarians so long as it costs them nothing, but all too many are deaf to those demands of humanity which cost them hard cash. Let any State strip only some of its citizens, and not all, of a portion of their wealth, and these labour under an injustice. This much at least can be said, that Britain's motives in the matter were the highest possible, but the sacrifice did not fall evenly over the whole population, and the result was that the Dutch settlers started to trek north, and in the end formed the Orange Free State and the Transvaal.

Diamonds at Kimberley, gold on the Rand, wealth in sight to dazzle the eyes and fog the minds of men of high integrity. What wonder if a few proved weak in the face of avarice and began to intrigue and plan to do anything to gain all they could. The Jameson Raid took place—a raid regarded by some as a gallant attempt to succour oppressed countrymen, by others as piratical as anything practised by Drake and his fellow free-booters. The highly taxed Britons, who were looked upon as aliens in the Transvaal and who possessed no vote nor representation in the State, had just cause for complaint. Whether there was cause for war is a debatable question. The Boers fought valiantly, and a more gallant foe it would be impossible to face. Britain's might was too much for them. They lost, after a protracted struggle, and the Dutch States were incorporated in the British Empire.

If a deal that happened then is better forgotten, much that has happened since may be remembered without shame. Consider the facts. To crush a stubborn foe, Britain was obliged to send what was up to that time the largest army that had ever been transported overseas; millions of money were poured out in order to round up these active burghers, who seemed to be in one place to-day and another far distant to-morrow. For three years the guerilla warfare went on,

with the Boers registering several bitter defeats against Britain, before Cronje was brought to bay and the trouble cleared up. In the circumstances, the conqueror might not be able to restrain a desire to oppress those who had fought for so long. That, after all, is human nature.

What did Britain do ? After allowing the disturbed States time to settle down, they became merged in the Union of South Africa and were given fiscal autonomy. The peoples whom Britain had warred against so fiercely were calmly allowed to settle their own differences and rule themselves. That seems almost worthy of Alice in Wonderland, but it was the right idea—the idea that springs from wise statesmanship coupled with a knowledge of human nature. The result is a United South Africa.

At the moment, South Africa is rather concerned about the new flag it has chosen for itself. The British element naturally want the Union Jack embodied ; the Dutch elements desire to exclude the Union Jack altogether. Racial prejudices are bound to be stirred up over such a problem. I personally would have solved the difficulty by excluding both Dutch and British colours from the flag and creating something totally new which could not stir up memories of the past. I believe the parties have compromised by flying the Union Jack at the same time as they fly the Union Flag. Anyhow, they have arrived at some agreement, and when people of similar races and temperaments begin to study each other's likes and dislikes there is bound to be hope for the future.

The remarkable, the extraordinary thing is, that a dozen or so years after they had been warring against Britain, the South Africans were fighting as strongly for her as they had previously been fighting against her. I maintain in the face of all the opposition in the world that there must be something good, something sound in Great Britain to win over a hostile people like that in such a short time. If we had been half as black as our

bitterest opponents paint us, we could never have done it. The Right Hon. J. C. Smuts proved himself to be not only one of the most outstanding figures of the war, but I consider him to-day to be one of the greatest statesmen now living. He is constructive, wasting no regrets over the past, thinking of the future and what it holds, proud to be a member of the British Empire, and determined to do his best to fuse the Dutch and British elements in South Africa into one nation whose aims and ambitions are the same—peace and prosperity to their own country and to the Empire to which they have the honour to belong.

If I touch on Newfoundland, it is merely to mention that it was actually the first of Britain's possessions beyond the seas, for Sir Humphrey Gilbert, who was Sir Walter Raleigh's half-brother, landed at St. John's and unfurled the British flag for Queen Elizabeth in 1583. Of those many other parts of the Empire, space is too short even for the briefest mention.

It is a fairly easy thing to gain an empire by the sword, but it cannot be held by the sword. Something more than force is necessary to hold far-scattered countries together : that something is not exactly easy to define ; it is a mixture of wise statesmanship, sturdy independence, a sense of justice, and many other qualities. Whatever these qualities may be, I maintain that the sons of Britain possess them to a greater degree than any other nation.

That the people springing from these small islands should dominate the world is one of the most amazing things in all history. Shakespeare says : " There is a divinity which shapes our ends," and millions of people at this moment firmly believe that Britain is the home of the lost tribes of Israel and that the British race is ordained by Divine Providence to rule the earth. The British-Israelites hold strongly to this faith and quote passages from the Bible in support of their contention. They regard the British Empire as " a miracle of Divine achievement."

Under the Union Jack are many nations, absolutely independent, ruling themselves. Britain created them, but she does not impose her will at all. They are proud of their independence, but in times of danger all these different peoples in the different countries band solidly together and become one people under one flag ; they are bonded by affection and not by force. They love these verdant isles which gave our Empire birth.

In this respect Britain is without peer among the nations. The British Empire, which has a population of 450 millions and a territory covering 13 million square miles, is living proof that Britons possess a genius for colonizing which no other people has equalled since the dawn of time.

The Empire is Britain's strength, something to be proud of, something for which we may give thanks to the heroes and freebooters who have made it what it is. And the Motherland which nurtured this mighty empire may find within its boundaries those magic links of co-operation which shall lead to the prosperity and happiness not only of the British people, but of all the nations of the Commonwealth !

CHAPTER XVII

BRITAIN THE BENEFICENT

THAT love for humanity which led Wilberforce and Pitt to emancipate the slaves and give them back their freedom is no new driving force in the political life of Britain. There was an element of it present in the spirit of the barons when they drove King John to sign Magna Charta amid that beautiful sylvan scenery at Runnymede, on the banks of the Thames, all those centuries ago, but stronger still was the determination to submit no longer to the injustices with which the king afflicted the people.

John's word was obeyed. He had but to command, and anyone who angered him was immured in gaol or executed. Innocent or guilty, it mattered not. The whim of a lawless king was the law. In going to France, he hoped to win victories which would enable him to deal with his recalcitrant barons, but his defeat left him at their mercy, and in their strength they obtained one of the greatest charters of justice and liberty the world has ever known. By it, no man could be put into prison without trial by jury; there was the same right for rich and poor, Jew and Gentile. "No freeman shall be seized or imprisoned, or dispossessed, or outlawed, or in any way brought to ruin: we will not go against any man nor send against him, save by legal judgment of his peers or by the law of the land. . . . To no man will we sell, or deny, or delay, right or justice." These simple phrases are the charter of our liberty, and King John liked them not. But there was wrath in his heart when he read that before he imposed any taxes on the people he must call "the common council of the realm."

That Great Council became our Parliament, with the right to control the expenditure of the king by voting him sufficient money for one year only. It was a perfect check to royal extravagances.

Persecution and oppression have been the birthright of the Jews throughout the ages, and it was their fate in England as elsewhere. Yet under the great charter even a Jew could not be thrown into prison without trial, and in this respect the Jews were on the same footing as barons, freemen, and serfs. They suffered untold cruelties when they were banished from England by Edward the First towards the end of the thirteenth century, and over three hundred years elapsed before a Jew was again allowed to put foot in the country. Then Cromwell set at naught the adverse decision of his advisers and allowed the Jews peacefully to filter back to Britain. Since then there have been spasmodic outbreaks of public opinion against them, but they have certainly suffered less here than in most other countries.

The freedom granted to Jews to vote and enter Parliament during the nineteenth century has not been unappreciated by their brethren in less fortunate lands. A tremendous influx of Jewish refugees from Russia and Poland and other places took place during the war, and these, with their children, are at present enjoying all those privileges which Englishmen have achieved with such difficulty and at so great a cost. The immigration of aliens into Britain, as into many other countries, is now restricted, and the flotsam and jetsam of other races cannot settle here so easily as they did in pre-war days. Large numbers of alien children are necessarily being educated in English schools free, while Englishmen, burdened with debt, are paying the cost. No wonder the aliens, Jewish and otherwise, have for so long regarded Britain as something approaching an earthly paradise !

I was told in 1926 that a foreigner buying a house in France must pay an extra tax, but I cannot confirm nor deny this. Foreigners in England may certainly

buy as many houses as they like, and pay the same fees that are exacted from the Briton. It is a fact that prior to 1914 the Jews were not in the habit of buying houses to live in; they much preferred to rent them. But in the past few years they have given themselves over to purchasing houses and making it a profitable business, for they will let rooms or flats to the Gentiles, and obtain the highest rent they can possibly get. There must be countless Englishmen to-day who are paying rent to aliens.

As for education, the institution of School Boards under the Education Acts, which later provided compulsory education free to all children, gave a fine lead to backward countries. And whatever may be said against free education, there is this much to be said for it—that under the system of scholarships there is no reason why any intelligent son of a working man should not win his way to a public school, and so to Cambridge or Oxford. The scholarships are there for those who have the ability to win them. The youngsters of to-day have chances which were unthought of half a century ago.

More than ever is the State taking care of the young. A special staff of doctors devote all their time to examining school children, looking at their teeth and prescribing free dental treatment, testing them for physical and mental defects, advising treatment for the ailing ones, and keeping a fatherly eye on those suffering from malnutrition. In thousands of cases poor children are provided at school with free milk and meals out of State funds. And those children who are mentally deficient—and too many, alas, come into this category—are sent to special schools, where they are properly looked after, while there are open-air schools for those with any tendency to tuberculosis. What Britain is doing in this respect is an example to the world, and I regret that I cannot deal with this wonderful work at greater length.

That care bestowed on the children is not withheld from the grown-ups. Under the State Insurance system, instituted by Mr. Lloyd George and based on the

German system, all the manual as well as most other workers of Britain are compelled to insure, and if they fall sick or become unemployed they are entitled to payments out of the insurance fund. Anything more humane cannot well be imagined. But its one great drawback is that it is starting to breed an idle race who much prefer to draw the " dole " rather than to work. I need not point out that no nation can exist without working, and that when it refuses to work it will soon cease to exist. As there is no such system in the United States, the incentive to find work there is much stronger than it is in Britain. Theoretically the idea of unemployment pay is good, but in practice it is subject to many abuses, and the lazy man finds ways of dodging work which are as ingenious as they are fraudulent. And it is obvious that the men who will work are keeping those who won't, an injustice which is bound to persist until all men are educated to a state of citizenship, and made to realize that if they shirk work they are placing an unfair burden on the shoulders of their fellows who are working. When that day comes, and the baser side of human nature has been swept away, all the citizens will be so prosperous and happy that the ideal State will be an accomplished fact.

Meanwhile we must take things as we find them, and if that State of our dreams is still non-existent, we must realize that Great Britain has done more than most nations to bring it about. Britain is the Mother of Parliaments, the first apostle of that creed which has been summed up as " the government of the people, by the people, for the people." The forerunners of Parliament existed in these islands before the Conqueror grasped the crown of England, and with it stamped on these primitive councils and took all power to himself. It was definitely the weight of the people behind the barons which compelled John to grant the Great Charter of Liberty.

Out of corruption our present system has emerged. As the years have passed the people have gradually

gained more and more control in the power of the State. The riot in Hyde Park in July 1867, when the crowd pushed down all the railings on the Park Lane boundary and swarmed into the park to hold the meeting that was illegally forbidden, proved to Disraeli that the temper of the people was not to be trifled with, and it forced the first Jewish Premier of Britain to table his Reform Bill. Since then more and more people have been entered upon the register of voters. The suffragettes shrieked, smashed shop windows, and clung round the necks of policemen, sometimes chaining themselves to the railings of the House of Commons, in their efforts to obtain the vote. They behaved like wild cats till *War* descended, when they instantly changed their attitude, worked like Trojans, and the suffrage after the war was as good as granted. Since then the so-called "Flappers Act" has put another large body of youths and maidens on the voting register.

The severest critics of this country must candidly admit that Britain has done her best to bring about government of the people, by the people, and for the people. The one disturbing element is that a vote does not carry with it a knowledge of economics and wise government, with the consequence that a large body of voters who pay no direct taxes may be induced to vote for something which is really against their own interests and those of the country. To those who remark that anything which is popular must be good, I would reply that the people do not always know what is good for them, and that a few acute men with the vision to look ahead may, if they are not obstructed, do more good for the State and the people than the combined weight of an uninformed public opinion. I should say that ignorance, and not greed, is the greatest bar to prosperity and happiness in this world.

Not without reason has England been called the Land of Liberty, and although our liberties have been seriously curtailed since the war, and I can be haled before the magistrates for purchasing half a pint of

milk for a child after eight o'clock at night, while I may go into a public-house and fill myself with beer and spirits without committing any legal offence, or any harm except to my digestion and intelligence, yet in spite of these anomalies this country still enjoys a larger measure of freedom than any other country. People with the most rabid views on any subject may address public meetings in Hyde Park—and it is typical of the Englishman that the more rabid the views the more the audience usually laughs. It is a terrible thing for a man who takes himself seriously to face an audience who regard him as a joke. What can you do with such people? Sometimes, of course, the speaker goes too far, and there is trouble; and a few stalwart men in blue march the disturbers of the peace off to the police station.

Reverting to the freedom enjoyed by the Jews—and the way they are invading this country, taking English or Scottish names and monopolizing some industries, especially the dressmaking and the clothing industries, as well as retail shops, is seriously disturbing to the thinking Englishman—the highest places in the land are open to them. They are to be found in the House of Commons and House of Lords; a Jew has been crowned Viceroy of India; another was Premier of England; they are found in the Cabinet, on the Bench, at the Bar, in the choicest positions in the Civil Service, and at the head of our biggest industrial and financial institutions. Sometimes, as in the case of Clarence Hatry, they may cause untold suffering and loss to large numbers of people, but as against this must be set the good which they do. If the worst elements of our Jewish population are prone to trickery and fraud, by far the biggest proportion are law-abiding citizens with a keen sense of business and an industry and ability which create wealth not only for themselves but for the State. I suppose that the Jewish element of our population is, on the whole, an asset, but the alien and Jewish names of candidates putting up for the last Parliament disclosed the possibility that in the future we may see a British Parliament and British

people governed by naturalized aliens and Jews—unless steps be taken to minimize that risk.

Britain has again shown an example to other nations by giving her people absolute religious freedom. Quakers, Catholics, and Protestants have each been persecuted here in their turn, but there has been little religious persecution in the past when compared with the Inquisition in Spain and the Massacre of St. Bartholomew, which sent the Huguenots fleeing for their lives to Britain for protection. The men who induced William of Orange to come to England and King James to flee to France, struck a shattering blow for Protestantism and religious freedom. Had William not taken a firm stand, Britain might have become a Roman Catholic country. Those who in their religious zeal are apt to be bigoted should always remember with gratitude that a Roman Catholic Archbishop of Canterbury, Stephen Langton, was mainly responsible for the Charter which gave us our liberty ; Langton was an Englishman who defied the Pope and allowed his religion to take second place when his country was in jeopardy. But it was actually half a century later, after three more kings had sat on the throne and misruled England, that the First Parliament was called to Westminster by Simon de Montfort in 1265.

A vast change has been wrought in the past century in the national consideration of the young and the old. The industrial age of Britain was ushered in with the blood and tears of infants. Children of seven and eight went down into the bowels of the earth to help to mine coal ; infants of four and five toiled in the cotton factories, in some cases babies of three years old were so enslaved. One of the foremost men to lead the reform in this terrible state of affairs was Robert Owen, who rigidly set his face against employing children in his factory unless they were at least eight years old ! Even that seems terrible to us now, but then it was considered so revolutionary, and the other humane methods he adopted in his factory were so outstanding, that people came from all over the world to see how his model

The Times

THE MOTHER OF PARLIAMENTS. IT WAS TO WESTMINSTER THAT SIMON DE MONTFORT SUMMONED THE FIRST TRUE PARLIAMENT IN 1265, YEARS AFTER KING JOHN WAS FORCED TO SIGN THE GREAT CHARTER OF LIBERTY. AROUND THE ANCIENT WESTMINSTER HALL, WHERE THE FIRST PARLIAMENT GATHERED AND MANY A TENSE HISTORIC SCENE HAS BEEN ENACTED, THE PRESENT HOUSES OF PARLIAMENT HAVE BEEN BUILT ON THE BANK OF THE THAMES, AND THE FORM OF GOVERNMENT THAT FIRST TOOK SHAPE AT WESTMINSTER HAS SERVED AS A MODEL FOR ALL THE NATIONS

factory was run. Not only did he refuse to employ children under this age, but he started a great ideal by opening a school, in which the infants could be taught. The Right Hon. J. R. Clynes, our present Home Secretary, was himself working half time in a cotton mill when he was only nine years old, and those who deplore the bitterness of some of the trade unionists to-day should realize that the unions owe their existence solely to the greed and inhumanity of the employers of the past.

Bad as were conditions then, however, they were still so much better than those of other countries, and we were so comparatively free from royal oppression, that France was driven to revolt in order to gain a measure of liberty similar to ours. Once she had gained it, she started to make war on her neighbours of Holland and Germany in order to force them to become republics. She turned the Netherlands into the Dutch Republic in her efforts, but she failed over Germany. The Russian revolutionaries are but following the French revolutionaries in their efforts to force the world to accept their ideas. It is indeed a remarkable instance of history repeating itself.

To come back to the distressing conditions that governed the rise of Britain as an industrial power, the babies were not only enslaved soon after they were born, but the old were flung on the dust-heap and allowed to starve. Nobody cared. A woman at twenty was old, at thirty she was worn out. And the men, as soon as they showed any signs of tiring, were callously discarded and someone younger taken on.

Now, by the granting of maternity benefit, the mothers of the working classes receive State aid when their babies are born, and the babies are looked after by the State from the cradle upwards, all through the school years. And when they go out to work, then the State is still paying millions a year to maintain them in health, and support them in sickness, to attend to their teeth, and provide sanatoria. And in old age, instead of being cast on the rubbish-heap to die, there is a State

pension of ten shillings a week to help to sweeten the remaining years of life. That is a noble accomplishment that the other nations may look up to with respect, if not with admiration. We may not be achieving all that we hope to achieve, but at any rate we are doing our best, and if we cannot at the moment do more for the British nation, that is because we have been much too generous to foreigners.

The spread of civilization is due in no small measure to the growth of postal facilities, and while postal systems that were slow and expensive have been operating in many countries for centuries, it is to Great Britain that the world owes thanks for the wonderful postal facilities available to-day. Sir Rowland Hill, in fighting for the Penny Post, was fighting to benefit all the world as well as Britain. Although the Postmaster-General of his day said that it could not be done, and that the Post Office could not possibly deal with all the letters that would be sent if a penny post were inaugurated, yet it was done. And the postal reforms which followed in the ensuing years eventually brought all the other nations into a Postal Union. The Post Office of the world is erected on British foundations, and it is impossible to measure the blessing conferred on humanity by the postal reforms of Sir Rowland Hill.

Nor must we forget the latest and perhaps the most wonderful movement of all which sprang to life in Britain. This is the Boy Scout movement, that has fired the enthusiasm of the boys of all nations—white black, yellow, red; Chinese, Japanese, Esquimaux, French, German, American, Indian. I believe I am right in saying that wherever there is a measure of civilization, there you will find Boy Scouts.

The concepts of the Scout movement cannot be too highly praised. The boys are taught to observe and love nature, they are given exercise in the open air, they are made obedient to discipline, their minds and bodies are developed, and they are taught to play the game of life, to be sturdy and independent, using their hands and

their brains. The great rallies which take place from time to time, when the Scouts of all nations gather together in camp to salute their leader, are doing more for the peace of the world than can well be imagined. But best of all is that rule of the Scouts which I regard as a sheer inspiration—that each Scout must do one good deed during the day. Just study the psychology of it. The new Scout every day is forced to seek his good deed until he has found it. This trains his mind to think of good deeds and his hands to do them, and in the course of time he does what good he can, because the desire to do so has become part of his nature. To make charity and kindness towards others one of the laws of the Scouts was a brilliant idea that will bear splendid fruit in the years to come.

Of all the forces which are working for peace in the future, I consider that Lord Baden-Powell is directing the most powerful force of all. Some time ago I met a lady who told me how Lord Baden-Powell inquired whether he might bring a few boys to camp on her estate. That was the very beginning of the Scout movement, and when this benefactress accorded permission, she had not the faintest idea that it would grow to such magnitude in so few years.

Lord Baden-Powell is certainly the biggest reformer of our time. He is the English genius who is taking the boys of the world from the gutters and forming them into a universal band of brothers whose creed is service to others. Of this I feel sure : Their exercises will do much to banish diseases of the body and mind, and their high ideals will assuredly help us to attain that lasting peace which we all desire.

CHAPTER XVIII

A LETTER FROM SIR FRANCIS DRAKE, THE PASSING OF NELSON, AND THE ECLIPSE OF NAPOLEON

FOR the greater part of his life Drake carried on a personal feud against the Dons, making them pay as dearly as possible for all that he had suffered in his first unfortunate encounter with them. Any ship of the Spanish Empire, big or small, was fair game to him, but the bigger it was the more he delighted in outwitting, outsailing, and outfighting it. Life was one glorious adventure, with Spanish gold as the reward.

Mighty as was the Spanish Empire, it differed fundamentally from the British Empire of to-day. The Spaniards went out to the South Americas, to Mexico and Peru, to spoil civilizations that already existed. In the case of Peru the civilization was of high attainments, for the Incas had arrived at the nearest approach to Socialism that any nation has ever reached before or since. For certain days in the year the whole people worked for the State, gathering in State harvests or planting State seed ; there were State granaries of corn to guard against famine, State stores of llama fleeces to be woven into clothing for the Royal house and the people, and the weavers wove so many yards for the princes and so much for themselves. If a man showed indications of being particularly artistic in beating and working gold or in carving, he was set to that work which he did best. Should a flood sweep away the holding of a native, then all the people in the vicinity lent their aid to help the stricken man to cultivate another area of land out of the reach of further floods and to build

another dwelling-place. Peace and content dwelt in the land, the people helped each other and the State, and were happy. This realm of bliss the Spaniards destroyed utterly; they conquered the people, killed and tortured them to obtain their stores of gold; plundered their most sacred shrines, and plunged the land into misery.

The gulf between the British Empire of to-day and the Spanish Empire of the sixteenth century is almost inconceivable. Britain generally has built her Empire by carrying the torch of civilization into the wilds, cultivating the land and winning it back from nature, fighting the jungles and forest, and building cities in what were once deserted places. Spain built her Empire by carrying the torch of incendiarism into existing civilizations and wiping them out. Britain has created, Spain destroyed; and the difference between the two acts is the measure of Britain's greatness.

Plundering the wealth of the natives made the Dons drunk with power. The gold they wrested from the stricken Peruvians and Mexicans was more irresistible than guns; with it they could buy almost anything they wanted. They flaunted their wealth in the faces of the nations until there was danger of the whole world falling under Spanish rule, with all the countries becoming mere states of Spain and paying tribute to her.

Other nations may remember this, when they are inclined to think harsh things about the British. These small islands of Britain have saved the world from slavery. War with Spain in the time of Drake was as inevitable as it was with France in the time of Napoleon.

For all her womanish wiles and diplomatic courtesies to Philip of Spain, Queen Elizabeth knew that England, like Holland, had either to fight or succumb; she executed Mary Queen of Scots, knowing that in removing this claimant to the English throne she would precipitate the war with Spain. The murder of Mary was a foul deed for Elizabeth to bring about, and it enraged Spain and the whole of Roman Catholicism. The Pope calmly

presented England to Spain just as a man gives a sixpence to a beggar, but the gift still remained to be taken. England was the one barrier against Spanish domination. If England fell, the rest of the nations were at the mercy of Philip.

While the Armada was being fitted, the invading army of Spain under the Duke of Parma was waiting in the Netherlands to be transported to our shores. As usual, England was unprepared. With but thirty-six ships in the navy to meet the one hundred and thirty-one ships of the Armada, the Admiralty was forced to scour all the ports round our coast for ships that could be fitted to fight. The majority of our ships which tackled the Armada were converted merchantmen and coasters manned by fishermen and seamen untrained in naval warfare.

While the work of fitting these ships was being hurriedly carried on in the ports, efforts were being made to gather an army to oppose the landing of the Spaniards. One day Elizabeth herself rode into the camp at Tilbury. "My loving people," she addressed them, "I know I have the body but of a weak and feeble woman, but I have the heart and stomach of a king of England too, and think it foul scorn that Parma, or Spain, or any prince of Europe, should dare to invade the borders of my realm; to which, rather than any dishonour shall grow by me, I myself will take up arms, I myself will be your general, judge, and rewarder of every one of your virtues in the field."

She begged Sir Walter Raleigh and Sir Richard Grenville for their advice on how to meet the situation; Lord Howard was Admiral of the Fleet, with Sir Francis Drake a Vice-Admiral. There can be few of our race who do not know of that famous game of bowls which Drake was playing on Plymouth Hoe when news was brought of the sighting of the Armada, of how he remarked that there was plenty of time to win the game and thrash the Spaniards too!

Howard's tactics were inspired. Knowing he was

LINLITHGOW PALACE, WHERE MARY QUEEN OF SCOTS WAS BORN IN 1542. HER CRUEL MURDER WAS A TERRIBLE PRELUDE TO THE FLOWERING OF ENGLAND'S GREATNESS UNDER QUEEN ELIZABETH, WHO RUTHLESSLY SWEPT HER RIVAL AWAY, JUST AS SIR FRANCES DRAKE AND THE GREAT GALE SWEPT THE AVENGING SPANISH ARMADA TO RACK AND RUIN

no match for the foe at hand-to-hand fighting, that he had not the men to overcome the armies aboard the Spanish ships if they grappled, he fought them at a distance and drove them into Calais, his smaller ships outsailing the big unwieldy monsters and giving them no rest from morning till night. Then as the Spanish ships lay huddled in harbour, eight fire-ships were sent among them and destroyed a number before the rest could get away, the others fleeing along the coast to Dunkirk, when Drake and Hawkins and Howard and Raleigh fell upon them and gave them a terrible battering. The smaller and lighter English ships with their shallow draught sailed over the sandbanks and harassed the Dons, firing on them until they had no shot left. If supplies of shot had not given out—and it is reminiscent of that shortage of shells which was to cause such a sensation centuries later—it is very doubtful if any ships would have escaped. A terrible storm spewed Spanish galleons all round the coast of Scotland and Ireland, and only thirty ships ever straggled back home. This staggering blow the Spaniards could hardly believe to be true. They seemed to discern in their defeat the ruin of all their hopes, and they lied for their very lives, sending broadcast the news of the glorious victories they had achieved.

Drake himself, stirred to indignation by these lies, wrote of them and the Spaniards as follows: "They were not ashamed to publish, in sundry languages in print, great victories in words, which they pretended to have obtained against this realm, and spread the same in a most false sort over all parts of France, Italy, and elsewhere; when, shortly afterwards, it was happily manifested in very deed to all nations, how their navy, which they termed invincible, consisting of one hundred and forty sail of ships, not only of their own kingdom, but strengthened with the greatest argosies, Portugal carracks, Florentines, and huge hulks of other countries, were by thirty of her majesty's own ships of war, and a few of our own merchants, by the wise, valiant, and

advantageous conduct of the Lord Charles Howard, high-admiral of England, beaten and shuffled together even from the Lizard in Cornwall, first to Portland, when they shamefully left Don Pedro de Valdez with his mighty ship ; from Portland to Calais, where they lost Hugh de Moncado, with the galleys of which he was captain ; and from Calais, driven with squibs from their anchors, were chased out of sight of England, round about Scotland and Ireland. Where, for the sympathy of their religion, hoping to find succour and assistance, a great part of them were crushed against the rocks, and those others that landed, being very many in number, were, notwithstanding, broken, slain, and taken ; and so sent from village to village, coupled in halters, to be shipped into England, where her majesty, of her princely and invincible disposition, disdaining to put them to death, and scorning either to retain or to entertain them, they were sent back again to their countries, to witness and recount the worthy achievement of their invincible and dreadful navy. Of which the number of soldiers, the fearful burthen of their ships, the commanders' names of every squadron, with all others, their magazines of provision were put in print, as an army and navy irresistible and disdaining prevention : with all which their great and terrible ostentation, they did not in all their sailing round about England so much as sink or take one ship, bark, pinnace or cockboat of ours, or even burn so much as one sheep-cote on this land."

The sarcasm of Sir Francis Drake, added to their bitter defeat, must have irked the Spaniards sorely. But they could do nothing. In grasping at the world, they had grasped a nettle which stung so fiercely that they were obliged to let go all that they held. And England in opposing the Spaniards was fighting not only for freedom of religion and the freedom of the seas, but also to free the continental nations from the yoke of Spain.

The smashing of the Armada began on July 20, 1588.

It was a long time ago, nearly three and a half centuries. No one could expect gratitude to last so long as that, for gratitude is one of the most ephemeral of human emotions : those who do good deeds to-day are frequently reviled to-morrow. But this much at least must be set down to the credit of England, that with her puny navy she was not afraid to face the nation that was bullying and buying the world, and in striking a blow for herself she was also fighting for those who were under the heel of the tyrant. The courage of England saved Europe.

With Holland in her turn ruling the oceans and seeking to monopolize all the trade of the East, it was England again who struck for the freedom of the seas and of trade. What the Dutchmen would not give out of justice they were made to yield by force. But the Dutch were skilful seamen and sturdy fighters, and it proved a ding-dong struggle, with victory and defeat alternating for both sides. The yarn that Tromp sailed with a broom at the masthead to signify that he was going to sweep the English from the seas, and that Blake replied with a whip to show what he was going to do to the Dutch, is probably a fable that sprang up after Blake had, indeed, thoroughly trounced the Dutchmen. I can recall no other case of a colonel in the army finishing his career as an admiral in the navy, except that of Blake. His defeat of Admiral de Ruyter was avenged by Tromp, who drove Blake back into port with his shattered ships. But Blake was not the man to rest under the stigma of defeat, and feverishly refitting his ships he sailed forth again and gave Tromp the beating which settled the Dutch claim to maritime supremacy. In the end, of course, there was a treaty, and the seas were free for all nations to sail and trade in, thanks to the dogged pluck of the British sailor-man.

The third time Britain saved Europe and the world was from the domination of France at the beginning of the nineteenth century. The oppressions which brought about the French revolution were more than

equalled by the bloody exactions of the revolutionists themselves. The wine of freedom and power flew straight to their heads and drove them mad. Instead of restraining licence, the revolutionaries cultivated it to a greater degree than those they superseded. Far from proving to the world that they were fit to hold up the torch of liberty, that they were true apostles of equality, and that fraternity was with them a living force, they, who preached fraternity, howled for the blood of the aristocrats and tried to wipe out the nobility of France by murdering them under the guillotine. In Russia the Bolsheviks have done the same with the Russian aristocracy: they have sought to destroy the very men, of high intelligence and breeding, whose co-operation would do so much to prevent the tragic blunders and wholesale butcherings which spring from the hatred of people who are unused to wielding power.

Moderation and toleration are two excellent policies which make for the happiness of the world. Extremism not only leads to much misery, but it often defeats its own end by creating a reaction strong enough to destroy it. While the world gasped at the excesses committed by the French revolutionaries, no nation made any attempt to interfere. The Frenchmen, drunk with success, were not content to confer republicanism upon their own country: they were something like the fox that lost its tail—they wanted to see all the other countries lose their tails too. As their fiery proclamations and words were not strong enough to achieve this purpose, they unsheathed the sword to force liberty, equality, and fraternity upon the unwilling countries around.

Ridiculous as it may seem to us now, there was then the gravest possible risk of Britain becoming a French colony, and Pitt, the English Premier, and Fox, the Leader of the Opposition, both realized this. But whereas Fox wrote and preached against the dangers of the French revolution, while he was so hostile that he urged for war against France, Pitt was firmly set on

maintaining the peace. He did not want war—knew the country was unprepared for war. So far did he go in the cause of peace that he intimated to the French that he would make no move if they occupied Belgium, but that if they attacked Holland he would be forced to declare war against France and protect the Netherlands.

France would not heed. Her armies attacked the Netherlands, and we were at war with her. With our help the French were thrown out of the country, only to return again and proclaim the Dutch republic. Then the unknown Napoleon threw the English out of Toulon and helped to capture that city, after which he smashed the Italians and the Austrians, proving that Robespierre was no fool when he selected the young Corsican officer to command the Italian army.

Much as honourable men may regret Napoleon's immorality, the veriest dunderhead must admit his military genius. With Austria and Italy at his mercy, he set in motion his great plan for domination in the East—Egypt, Syria, India, so ran his thoughts, and so it might easily have fallen out if England had not bred her Nelson. Paradoxical as it seems, Napoleon's army in Egypt was beaten by the English fleet. In three weeks Napoleon captured Egypt, but Nelson was dogging him, and, a month after Napoleon landed, the English admiral sailed into Aboukir Bay, where the French fleet of twenty ships was anchored. Sweeping between the hostile ships and the shore, Nelson started to shoot them to pieces. By nightfall, nearly all the French ships were sunk.

Napoleon was in Egypt, but he could not get out. Moving his forces along the peninsula to Syria he attacked Acre, but Sir Sidney Smith with another fleet defeated him, and he retraced his steps to Egypt, where a victory over the Turks enabled him to steal back to France, leaving the French army to be defeated on the shores of Aboukir Bay by the newly landed English army under Sir Ralph Abercromby.

All Napoleon's glorious dreams of Empire in the East were smashed by Britain. Not without cause did he hate the English. He realized that the one barrier to France ruling the globe was the little island that was so near to France, separated by a bare twenty miles of sea, and yet so far. While England was inviolate, her small population of fifteen millions was sufficient to counteract the aspirations of the forty millions of France. Her sea power was too much for the military power of Napoleon. The one way of smashing her sea power was to invade her. Such were the thoughts which chased through Napoleon's mind.

Let us give him full measure of praise for his largeness of vision, for his prescience that Britain was destined to trip him up. The sallow, introspective boy whom the other cadets at Brienne used to bully and jeer at had not brooded in vain. He had cultivated aims which were only bounded by the confines of this earth. Once Europe was won, the rest would gradually follow. And the astounding thing is that he was so nearly right.

It was unfortunate for Napoleon that at a time when he might have accomplished almost anything that he desired, England should have reared a naval genius like Nelson. This son of the vicar of Burnham Thorpe in Norfolk was so weakly in body that it is a wonder he ever attained manhood, yet for all his lack of physical strength, he did not know what it was to be afraid. When as a child he was lost, and found later sitting beside a stream, his grandmother said : " I wonder fear did not drive you home ! " " What is fear ? " Horatio Nelson replied. " I never saw fear ; what is it ? " But if he never saw fear, he knew what home-sickness was, when, as a boy of twelve, he went to join his uncle, Captain Suckling, aboard the *Raisonnable*; for his uncle happened to be absent, and Nelson was aboard over twenty-four wretched and lonely hours before anyone spoke to him !

In these wireless days, in which a vessel anywhere

can send a message to a vessel far distant, and telegraphs link up all towns and cities, we cannot realize the drawbacks Nelson suffered in searching for the French fleet in the Mediterranean. It was intuition which told him the French had gone to Alexandria; it was genius which led him to take his ships on the inside of the French fleet to drop anchor port to port, for he guessed that all the guns on the seaward side of the French ships would be manned, and those on the landward side would not. And he was right. French ship after French ship struck her flag; the French flagship blew up; only four of the French ships, anchored where they could not join in the fight, were able to flee in the morning. The French admiral was killed; Nelson himself they thought to be mortally wounded, a great flap of skin being stripped from his forehead and left hanging over his sound eye. As the surgeon came up to him, Nelson insisted on taking his turn with the men; and when his wound was dressed, he somehow crept back on deck and, while the French flagship blew up, ordered his boats out to pick up the survivors: they picked up seventy. Nelson lost just over eight hundred men, while the French lost over five thousand, in the ratio of nearly seven to one. He earned the pension of £2000 a year and the other honours that were showered on him.

He realized, as none other, what the success of the French designs would mean for his country and for mankind, and in consequence he gave these instructions to his midshipmen. "There are three things, young gentlemen, which you are always to bear in mind. First, you must always implicitly obey orders, without attempting to form any opinion of your own respecting their propriety; secondly, you must consider every man your enemy who speaks ill of your king; and thirdly, you must hate a Frenchman as you do the devil!"

But it is obvious that the hatred of Frenchmen was not to be carried so far as to let them drown after they were beaten, as his own order at the battle of the Nile proclaims. That he was merciful in victory is obvious;

that his bravery triumphed over the most dire physical agony was proved more than once. At the unsuccessful attack on Santa Cruz, when an adverse wind prevented him from manœuvring his ships where he designed to go, a shot through the right arm laid him low ; he was bleeding to death when his step-son tied a silk handkerchief tightly above the wound and stopped the blood from gushing out of the severed arteries. That action saved Nelson's life, but not his arm. Carrying him to a boat, they got him away, but he would not let them lift him aboard his own ship. " Let me alone : I have yet my legs left and one arm," he said. " Tell the surgeon to make haste, and get his instruments. I know I must lose my right arm, so the sooner it is off the better." He scrambled up a rope by himself. When he lost his eye through a shot driving sand and gravel into it, he refused to rest for more than one day ! The little Admiral with one eye and one arm seemed the reincarnation of a hero of legend.

Seeking to achieve by diplomacy what he could not compass by force, Napoleon had the satisfaction of seeing Russia and Denmark throw their weight against Britain ; with these new antagonists in the list the odds were decidedly against us. Thus Napoleon was striving to use the northern nations to whittle away our strength when Nelson came before Copenhagen. For three days he personally helped to sound the channels and replace the buoys removed by the Danes, who thought that no English ship would ever find its way unaided through the shoals. First making sure of the depth of water, Nelson took his fleet into the roads, dropped anchor, and began that battle during which the order was flown to withdraw, by his commander-in-chief—at that time Nelson was but Vice-Admiral, and under the orders of Sir Hyde Parker.

" Leave off action ! " quoth Nelson, when his attention was drawn to the signal. " Now damn me if I do. You know, Foley, I have only one eye—I have a right to be blind sometimes." He put his glass to his blind

eye. "I really do not see the signal." A little later he exploded. "Damn the signal! Keep mine for closer battle flying. That's the way I answer such signals. Nail mine to the mast!" Thus Nelson plucked victory out of defeat and won the battle of Copenhagen against orders, utterly smashing Napoleon's subtle plan.

On that occasion Nelson showed that he was a statesman, as well as a fighting man. Furious that the Danes should continue to fire upon their own ships that had struck their flags to him, Nelson wrote to the Crown Prince: "Vice-Admiral Nelson has been commanded to spare Denmark when she no longer resists. The line of defence which covered her shores has struck to the British flag, but if the firing is continued on the part of Denmark, he must set fire to all the prizes that he has taken, without having the power of saving the men who have so nobly defended them. The brave Danes are the brothers, and should never be the enemies, of the English." Calling for an imposing seal, he sent this note ashore under a flag of truce, and the Prince by messenger inquired the object of it.

Nelson replied: "Lord Nelson's object in sending the flag of truce was humanity: he therefore consents that hostilities shall cease, and the wounded Danes may be taken on shore. And Lord Nelson will take his prisoners out of the vessels, and burn or carry off his prizes as he shall think fit. Lord Nelson, with humble duty to His Royal Highness the Prince, will consider this the greatest victory he has ever gained, if it may be the cause of a happy reconciliation and union between his own most gracious Sovereign and His Majesty the King of Denmark." These notes, composed in the heat of battle, indicate clear thinking and high statesmanship. A century afterwards a Danish princess sat upon the throne of England—Queen Alexandra, the mother of our present King.

Napoleon, seeing his designs miscarry, became quiescent, and the Peace of Amiens in 1802 put Nelson on the leash once more, giving Napoleon a little respite to

gather his armies about Boulogne in order to attack and invade England. The Corsican was now First Consul, the preliminary step to proclaiming himself Emperor. By the most insidious propaganda he sought to undermine this country before his well-planned blow fell, but, instead of waiting for him to strike, England anticipated him by declaring war.

A hundred thousand French soldiers were encamped at Boulogne. " Let us but be masters of the Channel for six hours, and we are masters of the world ! " Napoleon exclaimed. That mastery required the presence of the French fleet to cover the transport of the invading army. But the French fleet was blockaded in Toulon, and although it escaped and led Nelson on a wild-goose chase across the Atlantic and back again, he brought it to bay with the Spanish fleet at Cap Trafalgar and flew that famous signal, which cannot be repeated too often, especially in these days : " England expects every man to do his duty."

On that day of October 21, 1805, he lost his life, but he saved England, not only from invasion, but from slavery. Twice he spared the French ship *Redoubtable* by giving orders to cease firing, for he thought she had struck her flag, yet it was from this very ship that he was shot by a marksman in the rigging through the shoulder and lung and back. " They have done for me at last, Hardy," he said to his devoted captain. " My backbone is shot through ! " Covering his face and his decorations with his handkerchief so that his crew might not know him, he was carried below.

Two hours later Hardy was in his cabin to tell of their victory, that fourteen or fifteen of the enemy had struck their flags. " That's well, but I bargained for twenty ! " Nelson murmured. Dying though he was, his mind was clear. He felt the storm that was approaching, commanded Hardy to anchor his ships, an order which was not obeyed and which led to several prizes going down. By the time the fight was finished, twenty ships had struck their flags, as Nelson expected.

" Take care of my dear Lady Hamilton, Hardy ; take care of poor Lady Hamilton. . . . Kiss me, Hardy ! " said the dying hero, and the captain who had more than once saved his life stooped and kissed him. To the chaplain he said : " Doctor, I have not been a *great* sinner. Remember that I leave Lady Hamilton, and my daughter Horatia, as a legacy to my country." For a few moments he was silent, then, as life ebbed, he murmured : " Thank God, I have done my duty ! "

On his desk was found an unsealed letter for Lady Hamilton, a letter delivered to her by Captain Hardy. The paper to-day has gone yellow, the ink has turned brown, but Nelson's last words to the woman he loved may still be read by those who care to seek them in the British Museum, and her lamentations on his death leap out at the end of the page. " Oh, miserable, wretched Emma ! Oh, glorious and happy Nelson ! " she scrawled in her grief.

Nelson was the greatest naval genius the world has ever known. A clean fighter, humane towards his foes, with a sense of statesmanship not often allied with naval or military prowess, this fragile wreck of a man, with one arm and one eye, struck the blow which saved England from invasion and Europe and the rest of the world from French domination.

" England has saved herself by her courage : she will save Europe by her example ! " exclaimed Pitt. But there were troublous years, in which England poured out her wealth to help her continental allies, before Napoleon was brought down to the dust.

The question of seizure of ships and contraband of war figured almost as largely in that struggle as in the Great European War a century later, and Napoleon very astutely brought in the United States to fight against England and cause us no little trouble before the difficulties were settled. Where he made his mistake was in seeking, in conjunction with the Spanish armies, to seize Portugal. An English army was sent there, and under Sir Arthur Wellesley, who afterwards became the

Duke of Wellington, it held the French at bay, while Napoleon flamed triumphantly across Europe to bring the Czar to heel. Moscow fell, and the Russians burned it to the ground. Left without a base, and with few supplies, Napoleon's Grand Army in the grip of the Russian winter became a retreating horde, whose dead were strewn along the dreadful tracks.

Germany and Austria were heartened to renew the struggle once more. Wellington, by dogged fighting, skilful advances, and judicious retreats, eventually drove the French out of Spain and across the Pyrenees. Then Napoleon began to taste the bitterness of defeat. He, who had ruled France and terrorized all the continental nations, was banished to Elba, and forced to see Louis ascend the throne. Not for long, however, did the Corsican submit to banishment. Escaping to France, the populace acclaimed him, the armies rallied round him, and he marched north to try to smash Wellington with the English army at Waterloo before Blucher could come up with our Prussian allies. Napoleon, when he saw the ground that the English had chosen to fight on, thought that already he had the English defeated. But Wellington had selected his ground with finer judgment than Napoleon realized: those gentle slopes up which the French had to charge were the most horrible death traps, the English troops in the face of attack after attack were not to be shaken, and as the last despairing charges of the Imperial Guard were thrown back, and Wellington himself led his men on foot to strike the last shattering blow, Napoleon, with his dreams of conquest as tenuous as the smoke drifting over the scene of carnage, fled towards Paris. The victory was won by the time that Blucher appeared.

"At last I have these English in my grasp!" Napoleon said, when he saw the line of the Duke of Wellington at the beginning of the battle. For days previously, the weight of the French army had driven Blucher back, had forced the English to retreat to Waterloo; but Napoleon misunderstood the English

temperament, and realized when it was too late that a retreat, though it so often leads to defeat, may sometimes bring about a glorious victory.

Abdicating the throne of France, he nominated his son as Napoleon II., before seeking to flee overseas, only to find the way barred. " Wherever wood can swim, there I am sure to find this flag of England ! " he said, and gave himself up at last to the captain of the *Bellerophon*, to finish his life in exile in St. Helena.

Patriotism is no crime, it is nothing to be ashamed of. Britain has right to be proud of her past. The naval genius of Nelson and the military skill and tenacity of Wellington sufficed to defeat the greatest military genius who ever lived. These small islands, with less than half the population of France, saved not only themselves but all the Continental nations from becoming the slaves of France. But for this nation of shopkeepers, whom the Continental peoples so affect to despise, the nations of Europe who are now in full enjoyment of their independence might to-day have been subject peoples in the United States of France !

CHAPTER XIX

THE BRITISH NAVY SAVES THE WORLD

CLOSE as we are to the greatest war of all, we are not too close to realize that in those awful years of 1914–18 it was Great Britain which saved not only Europe but the whole of civilization from destruction. This is the plain fact, and those foolish American films which suggest otherwise only serve to emphasize the inherent greatness of these islands.

The foul and inexcusable murder of the Austrian Crown Prince and Princess at Sarajevo, in Serbia, was but an excuse to commit a fouler crime. Germany was ready for war, was bent on war, and had that excuse not presented itself, another would have served. In the race to rival the sea power of Britain, Germany had taxed her people so heavily that they were rabid with discontent. The leaven of Socialism was working among the masses. From the declining years of the last century, all the efforts of the German statesmen were concentrated on creating the strongest army in existence—to turn the whole German nation into an army. But always there was a dread of what England might do, and they sought by any and every means to lessen the preponderance of the British Navy before launching the war which they fondly hoped was to make them masters of the world.

Had the Germans waited only another ten or a dozen years, they would have mastered the world by peaceful means. Their commerce was growing faster than that of any other nation, their business acumen was something to marvel at. Quietly and without ostentation they managed to acquire control of raw materials in parts of

the British Empire which were essential to industry. Nay, these raw materials were essential to something more than industry, they were the very sinews of war.

It needed the cataclysm itself to bring realization to our rulers. As Mr. Lloyd George said in the House of Commons on March 23, 1916: "There are industries which we have discovered to be essential for self-defence. Germany has very cunningly and craftily been building them up, not with a view to trade, but with a view to war. We found ourselves almost done because we had not got certain industries in this country. We have built them up slowly, but we have built them up, and we have built them up successfully. There are several new businesses which are essential to war as well as to commerce which we have built up, and it will be a fatal blunder if we ever allow these industries to go down. That is a question neither of Protection nor of Free Trade. It is essentially a question of national existence."

Volumes of diplomatic correspondence exist to prove that for years before the outbreak of war England was striving for peace and that Germany was merely waiting for "The Day" to start a war of conquest. The Germans could not wait another dozen years to achieve their aim by capturing the world's commerce. Long before that time Germany would have revolted under the burden of her own taxation. For years the taxes had been growing, and the taxpayers had been somewhat placated by the accounts of the wonderful war machine which Germany was creating. It was the rumble of revolution among the people, their increasing inclination towards Socialism, the recurring questions of what was the good of the Army, and why should they go on paying so dearly for it if they were not going to use it, that struck ominously on the secret ears of the Government and the Kaiser. Germany, with specious promises to her people, had induced them to find the money for the fighting machine, had held out vague hopes of what the machine would do when it was perfect, how it would bring

prosperity with huge indemnities and territorial aggrandizement to Germany and damnation to all enemies, and had so fostered the warlike spirit that it could no longer be controlled. Germany had either to go to war, or else to face the revolutionary spirit arising from a cheated populace at home. Considering her war machine invincible, Germany declared war. That day the whole population of Germany went delirious with joy ; it was as though they were all children who had been kept hard at work at school and their long-promised and eagerly expected holiday had come at last. Amid all the underlying factors, this is the main factor which caused the calamity to Europe.

Right till the last moment, Sir Edward Grey laboured for peace. Just as France was informed a century ago that if Holland were attacked Britain would be forced to go to war, so Germany was informed that Belgian neutrality must be respected, otherwise we would be driven to abide by the terms of our treaty and protect her. Germany also had in a treaty promised to respect the neutrality of Belgium, but that treaty, in the words of Bethmann-Holwegg, was just a "scrap of paper," to be honoured so long as it served, and to be dishonoured directly the opportunity arose.

For the appalling atrocities committed by the German troops in those first days in Belgium, I would refer readers to *German Atrocities, An Official Investigation,* by Professor J. H. Morgan, K.C., M.A. Little children, young girls, and women were violated and murdered ; civilians were shot like dogs ; the foulest deeds were done in the homes of the invaded people. As Professor Morgan says, "Some of the worst things have never been published." A Belgian of my acquaintance underwent experiences when the Germans descended on her village that would have driven most people permanently insane. Hushing these things up will give a false idea of war and incline a new generation to fight instead of arbitrate. Remembering them may help people to keep peace.

The twenty-four hours gained by the Belgian Army in holding up the Germans at Lille were invaluable: they gave France breathing time, they gave Britain a chance to complete arrangements for transporting the Expeditionary Force, those undying heroes of the "Contemptible Army," to France. And our own Intelligence Department, which was regarded rather as a joke in German Intelligence circles, owing to the way the German spies were able to get about Britain and report with apparent impunity, proved to be not quite so foolish after all. It left the German spies at liberty until the very last moment, calmly intercepting messages and seeing what was passing, without arousing the suspicions of the German Intelligence Department. Then at the psychological moment, when it was impossible to replace the organization, all the German spies were arrested, leaving the Germans without those secret reports of our movements which were so vital to them. And in secrecy, which the Germans failed to penetrate, our force of 80,000 men was carried over the Channel, and its appearance in the field at that particular spot came as a complete surprise to the enemy. Small as was the British force, it was an efficient fighting machine, and its prowess in defence and retreat lured Von Kluck forward faster than his commissariat and led to that fatal swerve of the German armies which enabled Gallieni to bring up his armies in taxicabs and omnibuses from the capital and so save Paris from capitulating a second time to the Germans.

How all the horses in Britain were mobilized and selected from our commercial firms, how commercial motor-vehicles were taken and shipped to France, how the men were got over without loss—these were some of the things indicative of most efficient staff work; and the planting of an army, complete with guns, transport, and everything necessary in France ten days after the declaration of war was the first of many miracles performed by Britain in the ensuing years. Had the British force arrived a day or two later, Paris would have

fallen. As it was, the French Government actually removed to Bordeaux, so great was the menace at that moment.

The vital factor which stood in the way of Germany, as it stood in the way of Napoleon, was that the British Navy held the seas. The whole British fleet had been commissioned to carry out the annual naval manœuvres, which came to an end on August 2. So disturbed by the ominous situation was Mr. Winston Churchill, then First Lord of the Admiralty, that he refused to demobilize the fleet, leaving the British Navy actually mobilized when war was declared. This refusal to disband the fleet was one of the wisest decisions ever taken, for which our own and future generations must always be deeply indebted to him. Under the protection of our Navy we were able to draw our supplies from the ends of the earth, and Lord Kitchener with most amazing foresight began to raise his army of volunteers, enlisting them for three years or the duration of the war. Everybody thought that three months would see the end of it, and Kitchener was laughed at for suggesting three years. Against his drawbacks, and trying to do everything himself was perhaps one of his greatest, must be set the sound common sense which enabled him to prepare this country for a long war.

Those early days were reminiscent of some farcical army in some musical comedy State. As the volunteers rolled in, all the tailors' shops in these islands were visited by inspectors who bought all the ready-made blue serge suits they could lay their hands on. Any size, any cut, any age—nothing mattered so long as it was a blue suit. The ready-made tailors sold all their old stock and netted fortunes. In the emergency, this did not matter. The volunteers were dressed in their blue suits, pending the arrival of khaki uniforms. The looms began to weave khaki as fast as they could and were kept running twenty-four hours a day, clothing contractors mobilized all the sewing machines and hands they could possibly find to make uniforms. All the shops

were combed for broomsticks with which the men could be taught to drill until real rifles arrived. Huge numbers of dummy rifles were made so that the real ones available could be used for real warfare until such time as the manufacturers were able to organize sufficient supplies.

Meantime the volunteers were marching about the countryside in their blue suits, looking something like convicts, and singing " We are Fred Karno's Army, No jolly good are we ! " They didn't sing " jolly," but any Tommy will tell you what they did sing. While the war was actually in progress, Britain set to work to create the biggest army that has ever taken the field. When the volunteers began to fall off, then every man between the ages of eighteen and forty-five was enrolled under conscription. Britain is a sea power. She was not prepared to fight the military power of Germany, but in the emergency she performed prodigious feats which have no equal in history.

In pre-war days I did my best to awaken public opinion regarding the aeroplane and the Zeppelin in the event of war. In an article published on November 30, 1912, I wrote : " France is feverishly building and manning a fleet which is to consist of a thousand aeroplanes. Already she has 200, and this year she is spending £1,280,000 to add another 300, making a total of 500. By 1914 she will have 1000. Germany, too, is striving to keep pace with her rival. Both these powers recognize the potentialities of the aeroplane. They realize that, aided by the aeroplane, they may become pre-eminent, while without it they may totter and fall ; so they go on doggedly building the 'planes and training the men. . . . Without air-scouts an army is blind ; its generals waste valuable time wondering what the enemy is going to do, striving to settle the vexed problem of discovering the most vulnerable point at which to strike, and the minute when to strike. The men may be marched for hours on end over rough country to a certain point, only to arrive, footsore and weary, to find that the enemy has disappeared ; field-guns may be dragged

across swift-running rivers to the tops of rugged mountains, all in vain. The air-scout changes all this, makes it impossible of achievement. Rising from the ground with a trained observer aboard to take notes, fifty or sixty miles of country can be searched in an hour, the movements of troops can be indicated on maps, encampments can be marked, weak points where an army may attack or slip through may be revealed, and the whole plans of the opposing army laid bare. . . . The expenditure of both Army and Navy upon aerial defence this year comes to less than £350,000. If we are lucky, by the end of next year we may have 240 trained men. France already has a corps of 400. Apart from scouting, bomb-dropping airmen can do a fearful amount of damage. The exploits of our naval airmen who flew over the fleet recently have provided the Admiralty with some startling data dealing with the chances of one skilled airman wiping out one or even two battleships, costing about £2,000,000 apiece. No longer is the aeroplane a doubtful quantity. It is as reliable in skilled hands as a motor-car. So we must hesitate no longer to follow the lead of France. We have the war-plane, let us train the war-plane men. We may want them to-morrow."

Three or four times in 1913 I published further warnings concerning the air menace, pointing out the danger of the Zeppelins, our unpreparedness to meet them, and the vulnerability of London. "We require, first and foremost, large numbers of war-planes fitted with quick-firing guns, so that in case of a sudden swoop of the German armada of airships across the North Sea we should at least be able to offer some defence, without depending on the weather to smash this new armada as it did the Spanish Armada of long ago." Other writers, of course, also did their best to rouse the authorities, but it needed the war itself to waken them to the horrible fact that the air menace was real. When war was declared, every civil pilot in the country volunteered for active service; they were shipped off to France at the

earliest moment, and with the very best machines that were available—and some were indifferent enough—they performed astounding feats and many of them died the most heroic deaths.

Gradually the whole of Britain was transformed into a huge arsenal to turn out munitions. Mighty works were erected for all sorts of purposes, new towns sprang up, those who could not fight in the trenches were set to doing war work. All forms of transport came under Government control, in time nearly everything was the subject of official supervision, meat and sugar and butter were rationed, and people were given food cards without which these necessaries could not be obtained. Customers had to register at certain shops in order to receive their rations. Petrol was also controlled and its use forbidden for pleasure purposes. A central marketing board was formed, which bought many of the essentials from overseas and distributed them in this country, thus preventing prices from being unduly forced up against us.

The nation may thank Colonel Repington, the correspondent of *The Times*, for that dispatch, in May 1915, which told how the attack on Fromelles and Richebourg failed owing to a shortage of shells, for it led to the formation of the Ministry of Munitions, which arranged for an output of big guns and shells that staggered some members of the Cabinet who, suggesting that the orders were too prodigious, were told by Lloyd George that they were not prodigious enough. Whatever people may think of Mr. Lloyd George's present politics, during the war he disclosed himself as a statesman of the highest order. Reverses left him unshaken. He was blessed with vision. He planned on so huge a scale, and aimed to produce such weights of guns and shells that eventually, when they opened up, he hoped to blast the Germans off the earth. His foresight proved more than justified, and no praise can be really commensurate for what he contrived in those troublous years.

A brilliant operation which might have shortened the war was heralded by a most unfortunate mistake. Mr. Winston Churchill's idea of an attack on the Straits of Gallipoli in an attempt to capture Constantinople was perfectly sound. The blunder lay in sending the Mediterranean fleet to batter on the door to let the Turks know we were coming. There was from the first little chance of the Navy forcing the defences of the straits, but had an army been put ashore when the Navy started operations, the soldiers could have walked right through. By the time the Army was ready to be landed on Gallipoli it was too late; the German officers had helped the Turks to plan and construct defences which proved impregnable. Even on the first day of the landing there was a gap through which the British troops could have passed, but the attack was not pushed home, the gap was closed, and the opportunity was for ever lost.

The one real chance of taking Constantinople, after the Navy had attacked the defences of the straits, was to land an army much farther away in some unexpected quarter. Without defences, with inefficient means of transport, the Turks would probably have been unable to withstand the expeditionary forces, and Constantinople would have fallen. It has been said that the suicidal folly of attempting a landing in the face of the defences that had been constructed was pointed out to the authorities, and the suggestion was made that the landing should be effected elsewhere; it was even urged that orders should be disobeyed to compass this, but the suggestion was not carried out. There never was a more glorious defeat, nor a more brilliant withdrawal. Everything was removed like clockwork in the night, and the Turks did not know we had vacated that fatal beach until next day. It was a marvel of organization. The tragedy of Gallipoli was enough to make the angels weep; the heroism of the men will never be surpassed.

To dismiss the epic of Lawrence of Arabia in a line or two is perhaps as gross an injustice as it is possible to

mete out to one of the noblest personalities of our time, one who sought neither profit nor reward for his doughty feats among the Arabs, but simply peace to live his own life—and eventually found that contentment as a private in the Royal Air Force. I can only urge readers to go to his book for his own deathless deeds, which helped Allenby to sweep up the Turks and led to the surrender of Jerusalem to two Cockney privates !

War in any case is inhuman, and the Germans were not disposed to regard any conventions or rules. By the rules their use of gas was specifically forbidden, yet the Germans had no compunction in letting it loose. The effect was devastating on the troops who were caught. They could not withstand it, and they had to give ground. Yet the Germans gained very little by it, and within a few hours thousands of women in England were hastily making gas masks for use of the troops in preparation for the next attack. The way all the troops in the front line were equipped with emergency masks in about twenty-four hours is a splendid tribute to the temper of the women who mothered the British Army.

All the time the British Navy held the seas. The German Navy was immured in Kiel, while the spirit of the German crews was gradually being undermined by inactivity. The news of the battle of Jutland on May 31, 1916, plunged Britain into gloom. Our losses were stated stark and bare without one word of comfort or explanation. Three battle cruisers blown up one after the other, three armoured cruisers sunk, eight destroyers lost. No word about German losses. It was unbelievable—the most smashing blow the people of Britain received throughout the war ; land reverses they expected, for they were not a military people, but the Navy was Britain itself.

Germany went mad with joy. The German Admiralty broadcast the news of its great naval victory, of the heavy British losses, and said no word about the German losses. That was where Germany blundered.

When it was found that a battle cruiser, a third-class battleship, and four light cruisers had been lost, all faith in German *communiqués* was forever destroyed. On the other hand, the stark statement of the British losses, without one shred of explanation or excuse, not only won the respect of the world, but it forced up British prestige to a pinnacle from which it never afterwards descended. That *communiqué,* more than all other things, convinced all non-combatants that they could have absolute faith in the British Admiralty reports, that Britain would tell the truth, however unfavourable. And when it was seen that the German fleet had fled for its very life back to Kiel and that it never dared to venture out again, it was realized that what the Germans hailed as their great victory was in reality the most crushing of all defeats—as indeed it was. The British Navy lost heavily at Jutland, but it swept the German Navy from the sea, and if the foe had waited for our battleships to engage, the German fleet that day would have been shot out of the water. About this there is no doubt. Conditions were difficult, the luck was with the Germans, and under darkness they escaped destruction. But from that day Von Tirpitz and the Kaiser and the German Admiralty knew that Britain was Mistress of the Seas. They could write their reports, issue their heartening *communiqués* to lull the German public, but the British Navy was outside waiting patiently for the day —which never came !

On the opening day of the war a moratorium was declared in Britain in order to prevent a financial crisis, gold was withdrawn from circulation and the strange and unfamiliar £1 and 10s. notes were run off the printing-presses by the thousand. That moratorium tided the country over the first shock. But the statesmen had a difficult time over the right to search neutral ships for contraband of war. America, as I have stated elsewhere, was driven to declare war against us over this very question when we were grappling with Napoleon, and in 1914 the situation became so delicate that only

by the most tactful treatment was American friendship preserved. It would in those early days have been the simplest, the easiest matter to push our right of search and confiscation to such logical conclusions that the United States might have withdrawn her diplomatic corps from our shores. A continuous outcry was being raised by our newspapers that huge quantities of cotton consigned to neutrals, but which was undoubtedly finding its way to Germany to be made into explosives, should be seized. To most patriots at that time, British statesmen seemed dense—but it transpired that if they were slow, they were none the less sure, for they arranged their orders to the patrols so diplomatically that American sympathy was retained instead of being alienated.

It was when the *Lusitania* was torpedoed in 1915 that a cry of horror rose throughout the civilized world. The inhumanity of that deed, the massacre of so many innocent men, women, and children, has never been equalled; the cold-blooded brutality of the crime branded Germany as an outcast. Yet German mentality is such that even now that atrocity is not only defended, but excused by some of the submarine commanders as a right and proper thing to do. Much as Germany wished to keep the United States neutral, by 1917 she was so desperate that she was obliged to take the risk of bringing her in on our side. The submarine campaign was launched, with those inhuman orders to sink all ships at sight, no matter whether they were passenger ships or warships, troopers or cargo boats. And the German commanders carried out their orders only too well. They torpedoed all sorts of craft, among them hospital ships and passenger liners.

So many American ships were sunk, and such an outcry was raised in America, that the President was at last spurred to action; and when our Intelligence Department furnished to the American authorities absolute proof that Germany was urging Mexico to wage war on the United States, that country handed Count

Bernstorff his portfolio; and on April 7, 1917, joined the Allies. How our Intelligence officers decoded and read the messages which passed between Germany and Bernstorff and Mexico is not the least brilliant of many brilliant feats they performed. The Germans imagined their system was proof against everything, and when they learned that something had leaked out they started to send querulous and condemnatory messages to Bernstorff, who naively replied that he could not understand how anything could possibly have miscarried—all of which the British officers read, not without joy and amusement.

The U-boats menaced our very existence. So heavy were our losses that we were obliged to adopt the practice of forming a number of ships into convoys which could be escorted by torpedo boats and other warships that were capable of dealing with the submarines. The neutral nations suffered so much that there was the danger of their refusing to trade with British ports—which was what the Germans were aiming at. But Captain Metcalfe of the Admiralty, in conjunction with some of the insurance brokers, worked out a scheme whereby all ships, neutral and allied, were fully insured by the State, and as any losses that might occur were thereby covered, the neutrals bore no financial risk at all, and were glad to continue to trade with Britain.

Those were harassing days to the Admiralty, and had we not fought back fiercely, the German hopes might perhaps have been fulfilled. The issue was far too doubtful to contemplate with equanimity. Luckily the British people did not realize it, and their faith remained unshaken. Every man and woman who could dig started an allotment to grow as much food as possible, and the allotment movement in Britain played a considerable part in defeating the U-boat war ; then imported food-stuffs were rationed most strictly, and the weekly supplies were sold only on production of the ration-card.

Further, the Admiralty developed to the full all

IN THE FOREGROUND ARE THE TWO HALVES OF A GERMAN FLOATING DOCK CARRYING BETWEEN THEM IN A CRADLE OF STEEL ROPES ONE OF THE GERMAN DESTROYERS TREACHEROUSLY SCUTTLED AT SCAPA FLOW. THE LONG ROD IN THE CENTRE IS ATTACHED TO THE DECK OF THE WRECK AND BY IT THE SALVORS MEASURED HOW FAR THEY HAD LIFTED THE VESSEL FROM THE SEABED. IN THE BACKGROUND ARE SEVERAL SALVED DESTROYERS BEACHED IN MILL BAY BEFORE BEING CUT UP AND SENT TO THE SMELTERS. IN RAISING THE SUNKEN GERMAN FLEET, MR. E. H. COX, WHO HAD NO PREVIOUS EXPERIENCE OF THIS WORK, HAS PERFORMED THE GREATEST SALVAGE FEAT THE WORLD HAS EVER KNOWN

possible defensive and offensive measures to combat the submarines. How they were fought with nets and mines and motor-launches and depth charges; how these measures gradually reduced the tonnage sunk and increased the losses of the submarines, while under comprehensive shipbuilding programmes the shipyards here and in the United States laboured night and day to get new ships into the water, is one of the most fascinating phases of the Great War. In my book *The Wonders of Salvage*, I lift the curtain to give an idea of what was done, and show how, in the very thick of the war, we were able to improvise in such a marvellous manner that the submarine menace was utterly smashed.

The ultimate surrender of the German submarines at Harwich, followed by the surrender of the German Navy itself and the treacherous scuttling of it at Scapa Flow, will not soon be forgotten.

As for the war on land, whole libraries already exist describing it. The battle of the Marne, when Von Kluck swerved before Paris and the German advance was checked, I have previously touched on. The defence of Verdun was marked by the almost superhuman heroism and self-sacrifice of the French. "They shall not pass!" was the cry. And the Germans flung away their men by the thousand in the vain attempt to shatter the defence. The frustrated attack of the French on the Chemin des Dames is one of the major tragedies of the war, vying with that of Gallipoli. And the British defence at Ypres is one long, undying story of heroism.

Belgium, in defending its neutrality, struck the first shattering blow which led to the downfall of Germany. Russia, throwing forward her ill-equipped armies, sacrificed her men and succeeded in easing the pressure on the Western Front by drawing off German troops. Italy kept large numbers of Austrian troops engaged who might have been fighting with greater effect elsewhere, but the Italians needed the stiffening of the British troops before they were able to smash the Austrians.

The French were wonderful. The Latin temperament is all for activity, and I could not imagine our French friends sitting down calmly and enduring trench warfare for years. The fact that they were able to school themselves to endure the monotony and mud astonishes me even now.

As for America, she came into the war far too late to achieve much, but if the campaign had lasted another year the United States might have proved the deciding factor. As it was, the Americans came in when the task was all but finished, and they had only to sweep up the pieces, so their strength was felt more in the Council Chamber than in the field, and owing to the fact that the Allies were so deeply in the debt of the United States they were forced to pay attention to the demands of President Wilson in framing the treaty of Versailles. Future generations of all nations should be grateful to President Wilson for his part in creating the League of Nations, although they may not understand why the country which officially inspired the formation of the League should by reason of its political system refuse to become a member of it. So far it is Britain who has carried the League on her shoulders and borne the brunt of the expense.

After we have given all the Allies due credit for their deeds, after recognizing what we owe, in a double sense, to the United States, the plain fact remains that it was British sea-power which won the war, that it was the naval blockade of Germany which brought the Germans to the ground. It was the British Navy which prevented Germany from mastering the world, and consequently without any doubt it was Britain which saved civilization, including, of course, the United States.

But on the Continent it is all too common to see people slowly close an eye and hint that Britain was wise in selecting France for her battle-ground. The insinuation is as base as it is groundless. Prince Lichnowsky, the German Ambassador to London, stated in the

THE AUTHOR OF THIS BOOK JUST ABOUT TO HAVE HIS HELMET FITTED BEFORE DIVING TO THE BOTTOM OF SCAPA FLOW TO EXAMINE ONE OF THE SUNKEN GERMAN BATTLESHIPS. THERE WERE SIGNS THAT THE APPORTIONING OF THE GERMAN WAR-[illegible] SCUTTLING THE GERMAN FLEET VON REUTER, BY HIS TREACHEROUS ACTION, ACTUALLY PERFORMED A SIGNAL SERVICE TO HIS FOES

Vorwaerts the simple truth, which was translated as follows by *The Times*: "My mission was wrecked, not by the perfidy of the British, but by the perfidy of our policy." And under the heading "Question of Guilt" he wrote: "As appears from all official publications, without the facts being controverted by our own White Book, which, owing to its poverty and gaps, constitutes a grave self-accusation: 1. We encouraged Count Berchtold to attack Serbia, although no German interest was involved, and the danger of a world war must have been known to us—whether we knew the text of the ultimatum is a question of complete indifference. 2. In the days between July 23 and July 30, 1914, when M. Sazonoff emphatically declared that Russia could not tolerate an attack upon Serbia, we rejected the British proposals for mediation, although Serbia, under Russian and British pressure, had accepted almost the whole ultimatum, and although an agreement upon the two points in question could easily have been reached, and Count Berchtold was even ready to satisfy himself with the Serbian reply. 3. On July 30, when Count Berchtold wanted to give way, we, without Austria having been attacked, replied to Russia's mere mobilization by sending an ultimatum to Petersburg, and on July 31 we declared war on the Russians, although the Tsar had pledged his word that as long as negotiations continued not a man should march—so that we deliberately destroyed the possibility of a peaceful settlement. . . . In view of these indisputable facts, it is not surprising that the whole civilized world outside Germany attributes to us the sole guilt of the world war."

Few people can realize the bravery required to write and publish such words. They proved that Lichnowsky possessed a moral courage which enabled him to face the truth and recognize the facts.

Obviously the insinuation that England selected her battle-ground wisely is false. It was Germany who selected France as her battle-ground, it was Germany who, by violating the neutrality of Belgium, forced us into

the war. Our national honour was so involved that had we not fought we should have deserved to perish. When the gage was down, we were compelled to accept it. It was Germany's most favourable moment, and not ours. We fought for Belgium and France and for Europe. Naturally we fought for ourselves, too. None the less, this much is obvious. If Germany had not embroiled us, she would have conquered France and brought the Continent under her heel. In a year or two she would have brought all her forces to bear on us. On that day we should have stood alone, without any support whatsoever. When it is considered that Germany withstood the world for four years, could we have withstood her if she had occupied Calais and congregated a mighty army there to invade us ? We should have been just as unprepared as we were when the war started, and with a German fleet augmented by the captured French fleet I am afraid that our chances of surviving as an independent State would have been negligible. The same argument, of course, applies with equal force to the United States.

A cynical but logical Frenchman once remarked to me that America had far stronger reasons than those of England for fighting against Germany. When I inquired what they were, he admitted rather unwillingly that there might have been some degree of altruism about Britain's action, but suggested that the United States fought for purely financial reasons. The United States was content to make munitions and drain away all the gold of the Allies as long as possible, the American financial magnates were even pleased to arrange huge credits on our behalf ; but when the American financiers saw the Allies so exhausted, with the possibility of Germany winning, they also realized that in this event there was the possibility of the Americans losing all the money they had lent to us. He stated frankly that America fought because she could not afford to let Germany win, that the American armies moved at the touch of the financiers to save all the money the Allies

owed. When I protested, he just smiled. "Look at the hard bargain America drove with Britain over the debt! Isn't that proof?" he asked.

Such extreme views are not pleasant to hear, but it is far better to face the issue and realize that many people who possess a material and logical outlook on life believe them, than it is to remain blind to their opinion. The point, of course, concerns America and not ourselves. The deliberate way in which Mr. W. B. Shearer succeeded in working against the proposals to cut down the size of our navies at the Naval Conference in Geneva in 1927, so as to ensure the placing of orders for several new American warships with the American armament firms, is very significant; Shearer was paid by armament manufacturers to do what he did; it reveals that some American business men are more concerned with making profits than in maintaining Peace—that Peace, to armament firms, is not a paying proposition. Unthinkable as this seems, the American courts have proved it to be true.

Fortunately the latest Naval Conference in Britain has brought some measure of accord between America and Japan and Britain, which, so far as it goes, is good. We can only hope that the next Naval Conference of the Powers will carry it a step farther and make it better still. It cannot be too often reiterated that if a people are heavily taxed to create a fighting machine, the desire to use the machine will one day prove too strong and war will result. As well expect a man who has spent his whole life designing the fastest motor-car in the world, and his whole fortune in building it, to toy with it for the rest of his days in his garage without attempting just once to try it out and break all records. It is against human nature. This was the psychology which drove the Germans to plunge the world into profound misery and burden us with debt for generations to come.

CHAPTER XX

BRITAIN ALWAYS PAYS

GREAT BRITAIN during those fateful years when Germany was seeking to conquer Europe raised and trained and equipped an army of 4,970,902 men and a naval force of 407,316 men ; these, added to her total forces in existence at the outbreak of war, gave her a total Army and Navy of 6,159,399—a stupendous achievement. Canada enrolled 610,636 men ; Australia's contribution to the cause was an army of 416,809 ; New Zealand sent 124,211 men ; South Africa enrolled 136,074 men, and under the leadership of General Smuts the Germans were vanquished in Africa. Nor must we forget that in India's army of 1,338,620 men were many gallant soldiers whose fealty led them to take the tremendous step of disregarding their religious observances in order to serve the British Raj overseas.

In all, Great Britain and Ireland and India and the Dominions raised and trained and equipped an army and navy and air force of 9,291,526 men. These figures alone reveal the wonder and greatness of the Empire. The British Empire lost over 1,069,825—one in nine slaughtered by the war machine which Germany started and could not stop. To paraphrase Kipling : " If this be the price of our Honour, Lord God we ha' paid it in full." The finest flower of our youth, with all the budding genius and talent, sacrificed to war !

Britain spared nothing, withheld nothing. Her whole man-power was utilized to fight for France and Belgium and Europe ; her wealth was poured out without stint. During the Napoleonic wars, Britain,

helping her allies with men and money, increased her National debt in three years by £80,000,000. That was considered a gigantic sum, and in the ensuing years this country suffered from the usual depression which follows most wars.

The time came in the war of 1914–18 when we were spending as much as over £7,000,000 a day ; in eleven days we spent more than in three years during the Napoleonic wars. The Allies ordered their munitions, their guns and rifles and shells and uniforms and aeroplanes, and Britain paid. All the foreign securities held by Britons at home were mobilized and pledged with the United States as security against the credit given there. The financiers of the United States, chary of giving further credits to France and Italy, were quite prepared to trust Britain. This country shouldered the burden. The Allies sent their orders for munitions through Britain to America, and Britain accepted the responsibility for paying those debts. That was not the time to quibble. If we had not agreed to pay, we should have paid more heavily in defeat. Britain passed her word to the United States, and accepted the word of her Allies that they would pay her.

At the end of the war, Great Britain's National Debt had grown to £8,000,000,000. The late Lord Balfour made the noblest offer of all when he suggested that the debts between the Allies should be completely wiped out. By that magnanimous offer under the Balfour Memorandum, Britain would have made the greatest sacrifice. But America, which had garnered all the gold in the world into her strong-rooms, refused to forgo payment of her debt—with interest.

It should here be recorded that where figures in speeches differ from those which I give, the difference will mainly be due to the desire of the speaker to give round figures which are easily remembered ; in other cases some alteration in the statistics may be due to the time factor. For instance, the National Debt is slowly decreasing year by year, whereas the death-roll

of our war heroes is still increasing and is not yet complete.

In tabling a motion in the House of Lords to approve the principle of Balfour's splendid proposal, on May 2, 1929, Lord Birkenhead said, in the course of his speech: "We lost nearly 1,000,000 men in all the theatres of war. We flung into the war the garnered resources of a hundred years of peace and successful commerce. We had never counted the cost either in terms of men or in terms of money, and the question still remained in what attitude did we propose to face the post-war world, and those who owed us money. We took a view, which throughout the pages of history would be recounted as memorable, as ennobling the history of England . . . . We took the view that those who fought side by side, who travelled along the milestones which marked that bloody road, should not make money or charge interest to one another. No greater gesture was ever made by a country which suffered from the wounds which almost destroyed us in the War.

"It was the hope of the British Government at the time that the Balfour Memorandum received the unanimous consent of the Cabinet that those proposals might have been acceptable in the quarter whose decision was decisive. It was not found to be so acceptable. I attempt neither criticism nor complaint. The American nation, whose international charities, privately exercised, have been upon a scale which the world has previously never known, and whose humanity and sentiment no one has ever been foolish enough to impeach, did not, in this matter, take the view that inspired the Balfour Memorandum. Had they taken it, it would have been a most suitable conclusion to a great and perilous comradeship-in-arms.

"Let me make it again meticulously plain that there was and had been no complaint of the steps which America took. They were the masters of their own financial policy, as we were the masters of ours. But

nevertheless it should go out to the world that Great Britain at the end of the war was prepared to forgive every debt that was owing to her on the basis of a complete cancellation of debts. We have never had the credit from the world that we were entitled to for that. At that time nobody knew what amount of money could reasonably be obtained from our late Allies. We were determined not to adopt the attitude of bailiffs in pursuit of a debt. That seemed to us entirely unsuitable in the circumstances in which we had waged the war. . . . As a result of the war, £2,000,000,000 was owing to us from our late Allies, and our debt to the United States was roughly some £900,000,000. But those figures required a very considerable revision.

"It must be remembered that one-third of the £2,000,000,000 was owing to us from Russia. That nation, under the guidance of an immoral gang of adventurers and world revolutionaries, has repudiated completely that debt. A country with such vast resources, skilfully and soberly reconstituted after the war, could have repaid that debt while still retaining her international reputation and quality. She has chosen, under that mad guidance, to repudiate it. She is slowly sagging into ruin."

At that time the Conservative Government was in power, and Mr. Philip Snowden aroused a storm of indignation by stating bluntly in the House of Commons that France was "bilking" us. Although bitterly attacked on the following day, he refused to withdraw the term which so many people considered offensive: it cannot be too widely known that Mr. Snowden was but stating in the House what everybody was whispering under his breath. Mr. Snowden further characterized the Balfour Memorandum as "infamous," by which he meant that he disagreed not with the proposal to cancel all debts, but the offer to accept no more from our Allies than sufficient to pay our half-yearly contributions to the United States.

At the end of the war Russia owed us £722,000,000,

France owed us £623,000,000, and Italy owed us £533,000,000; there were in addition debts owing to us by other Allies. To lend this money we had been forced to borrow that £915,000,000 from America.

The United States insisted that Britain should pay her debt with 3½ per cent. interest. As a concession they agreed for the first ten years to charge only 3 per cent. interest. We are honourable people and our word is our bond. What else could we do but pay? Because the Russians repudiated *their* debts and have not paid any interest on my own bonds since 1917, am I justified in repudiating *my* debts? That is unthinkable. I was driven to borrow, like the British nation—and suffer in silence while the British Government gave British money to help Russian refugees: the British people ruined by the Russian repudiation of debt might starve, there was no help for them. We are indeed a peculiar people. We might try at least to learn the lesson that charity begins at home.

"Mr. Baldwin went to America and made a settlement which Bonar Law described as having put our people into bondage for two generations," said Mr. Snowden at Maidstone. "Mr. Churchill has accepted a settlement with France and Italy which means that we shall get hundreds of millions less than the total debt. The result is that the taxpayers of this country have to shoulder a payment of fifty millions a year, equal to a shilling on the income-tax. I am asked if I wish to be a Shylock in the eyes of Europe. I am the last man to be hard on a poor debtor, but France is the most prosperous country in Europe. We shall never succeed in maintaining international goodwill except on a foundation of fair dealing between nation and nation."

For years attempts were made to induce France and Italy to meet their obligations; the discussions were eternal and the net yield nothing. Then Mr. Churchill in a generous mood suggested that Britain would cancel £396,000,000 out of the French debt of £623,000,000 if France would agree to pay the remainder. She agreed,

but even now she has not ratified that agreement. Better terms were proposed to Italy, who was left with a debt of only £87,000,000 instead of £533,000,000. And the people of Britain have got to go on for ever paying the interest on that huge cancelled sum of money, which was raised in this country by war bonds and war certificates in order to lend to our Allies. The interest costs us, according to Mr. Snowden, 1s. in the pound income-tax.

While France has been pleading that she could not pay, she has been building up her own prosperity. She has no unemployment problem to-day; she exports £100,000,000 more than she imports, which shows how she is flourishing; far from having difficulty in making ends meet, she is this year remitting over £40,000,000 of her taxation.

Nothing can be more illuminating than the figures showing how much the various nations pay in taxes for every man, woman, and child:

Great Britain	£15	2	8
France	8	5	10
United States	6	1	11
Germany	5	6	5
Italy	3	8	9

If Britain had not her terrible burden of the National Debt she would be paying only £8 2s. 8d. per head, or about half her present taxes.

So far as our repayments to the United States are concerned, up to the end of the financial year ending April 5, 1930, we have, according to Mr. Snowden, paid £279,473,000 to America. This sum, be it remembered, is to meet the obligations contracted on behalf of our Allies. They in their turn have paid us only £48,825,000, so we are over £230,000,000 to the bad. In addition there is a matter of £60,000,000 in interest owing to us from our Allies! But to lighten our burden somewhat Germany has paid us £98,000,000 in Reparations. We

pay in taxes twice as much as France, two and a half times as much as the United States, three times as much as Germany, and five times as much as Italy. Our burden is so intolerable that it is steadily crushing the country. And it raises the price of our manufactured goods so high that our settlement of the war-debt problem has virtually subsidized all our trade competitors.

Germany, with an astuteness which was amazing in its simplicity, depreciated her currency until it was worthless, and wiped out all her internal and external debts. That was a form of capital levy which ruined large numbers of her people, but it enabled her to clean the slate.

France also depreciated her currency until it was worth only one-tenth of its pre-war value, and in this way she has taken a huge sum of many millions out of the pockets of English people who lent her money and bought her war bonds. To-day France has stabilized her currency at 125 francs to the £1, which means that British holders of her bonds are deprived of roughly four-fifths of the money which they lent. It is the equivalent of confiscation, but France is not much concerned about that. Yet she was very concerned when the Brazilian Government made preparations for repaying some loans raised in France between 1909–11 because the Brazilians proposed to repay in francs. France demanded repayment in gold because the franc had depreciated to a fifth of its value when the loans were made. The French Government, apparently, is quite willing to repay its pre-war loans in the present depreciated currency, but it is unwilling to accept its own depreciated currency in repayment of loans made by France before the war.

Another instance was provided when Japan requested permission to place part of a new loan for the City of Tokyo in Paris. The French Minister of Finance replied that he would authorize the floating of the loan when Japan started to pay the interest on the old City of

Toyko loan in something more than French depreciated currency.

In some cases the French have compelled foreign debtors to agree to new terms that are favourable to France. But the distress of the English who have subscribed to the French loans in London is utterly ignored by the French authorities, who, in spite of repeated representations, continue to pay the interest in the present depreciated currency. The war loans placed in London and Dublin were guaranteed at the date of issue against the imposition of all French taxes; but, as it turns out, the French have made what really amounts to a capital levy of at least three-fourths of them by allowing their currency to be depreciated.

For the four French loans of 1915 to 1918, over £49,000,000 was subscribed in Britain, and the French Government is proposing to repay, at present rates, just over £13,000,000, leaving British investors to face a loss of £36,000,000. Britons will be repaid £1 for every £4 lent! "The whole matter is a distinctly unpleasant incident in international financial history," comments the *Observer*. French people who have suffered by the Soviet repudiation of Russian loans are bitter in their denunciation of the Soviet and cry loudly for justice; but there is a discreet silence in France regarding the losses inflicted on British investors who subscribed to these French loans.

As a specific instance of how English people are suffering, I may quote the letter of Mr. J. C. St. Quintin which appeared in *The Times*: "An Englishman from 'purely patriotic motives' invested during the war £38,000 in subscribing for French Five per Cent. Rentes through the Bank of England, which subscription upon his death in 1922 was valued for probate at £21,000. His widow still holds the stock, and it is to-day worth about £4000, and the interest thereon has proportionately diminished. It seems incredible that the French nation, who are now in prosperity, should not make some compensation to those who came to their rescue at a

critical time and provided them with money with which to carry on the war."

It is a fact that France charged Great Britain for the rent of trenches during the war, but I cannot find out the sum that we paid, and I am told, in response to inquiries, that the said rent was charged " for trenches in back areas." It has been suggested to me that this payment is better forgotten, but if there was no harm in our paying rent for trenches in France—even in back areas—there can surely be no harm in placing the fact on record. As against this must be recorded the fact that France has made no charge for the graves in which our brave fellows sleep: the ground has been given free.

I repeat the concluding phrase of the telegram which the Prime Minister, the Right Hon. J. Ramsay MacDonald, sent to back Mr. Snowden at the Hague in August 1929: " We have reached the limit of inequitable burden-bearing."

Viscount Castlerosse, mentioning the price we paid in human lives for saving France, wrote in the *Sunday Express* of May 25, 1930: " As far as any understanding or mutual sympathy between France and England is concerned, I fear that my comrades have died in vain. France does not remember our sacrifices, and cares not at all for England now that the German menace has been removed." Hard words, but true.

Had America been prepared to sacrifice her loan of £900,000,000 as we were prepared to sacrifice our £2,000,000,000 of debts owing to us by our Allies, Europe to-day would be a far happier place and her problems would have been much simplified. But America insisted upon repayment—with interest. There was no impassioned Portia to plead for mercy in this case:

> " The quality of mercy is not strain'd;
> It droppeth as the gentle rain from heaven
> Upon the place beneath: it is twice bless'd;
> It blesseth him that gives, and him that takes."

No. America stood for the debt, the whole debt, and nothing but the debt—with interest. As America is not ashamed to take our money, and we are too honourable and proud not to pay what was demanded, I do not think America will be much concerned about this plain statement of a depressing fact. Let us be logical in the matter and admit that the attitude of the United States is purely commercial and commercially justified.

But there is another debt to which America never refers. It is the debt of those eight of her States which have not only defaulted in their repayments, but have repudiated all liability—just as the Russians have done. These debts, which amount to £78,000,000, were repudiated before the American Civil War, as far back as 1853. And the British holders of those bonds have never since received one penny piece. With accrued interest the debt now amounts to £200,000,000, and the major portion of it was owed to people in this country.

Lord Redesdale, speaking in the House of Lords on this subject, said on March 12, 1930 : " There is a great deal of feeling about these defaulting States in the United States of America, and it might well be that the Federal Government would welcome an invitation from His Majesty's Government to reopen the whole question. A settlement of this question would raise the defaulting States from the level of Russia, which is the only other State at the present time which is a defaulter by repudiation, and which is regarded by the United States as a sort of financial leper. It would also give the United States an opportunity of erasing from its history a painful and shameful page. These are strong words, but they are not my own ; they are the words of President Roosevelt, and express a view shared at various times by many eminent statesmen of both parties in the United States."

On the same occasion Lord Banbury, in supporting Lord Redesdale, stated the view of every honest man on this matter. " I fail to see," he remarked, " why, when the United States are creditors, they should claim that

their debtors should fulfil their bargain, and yet when they are debtors they should take no steps, as they could do, to make their subsidiary States pay their debts. In business, if a man owes another man money, he looks to see, before he pays the debt, whether he has any counter-claim against his creditor. If he has such a counter-claim, he deducts the amount of it from what he has to pay to his creditor. We are paying the United States a very large sum of money at present, but the United States, or rather their subsidiary States, owe us money. Why should we not say to the United States : ' We owe you so much ; you owe us so much. We will strike a balance and pay the difference.' That seems to me to be a reasonable proposition, and one which the United States could hardly oppose."

In discussing British War Debts before Congress on February 7, 1923, the President of the United States said : " The call of the world to-day is for the integrity of agreements, the sanctity of covenants, the validity of contracts."

There is in this instance an excellent opportunity for the United States to practise what it preaches.

The viewpoint of the British Government is that, as the Federal Government has no control over the financial obligations of its component States, and as the loans were made privately, there is no ground for raising the matter with America. But I wonder how the American people attempt to reconcile the irreconcilable, how they can justify their insistent demand to be paid every penny owing to them by Britain, while repudiating the debts they themselves owe to Britons.

Sitting in the Lobby of the House, waiting for a friend, a year or two ago, I was accosted by an American who told me that he had just been listening to Mr. Chamberlain, for whom he had a great admiration. " And did he tell you how America has stood us on our heads and shaken all the money from our pockets ? " I inquired rather bitterly. He was typical of the great majority of people in the United States—he knew nothing

about the debt question at all. When I explained it, he shook me by the hand and said : " You're a great people ! "

Who can deny it ? Yet among the continental peoples our generosity and humanity have been mistaken for weakness. We have been regarded as the fools of the human family, who would go on giving and giving and giving every time France or Italy or other State importuned us. These countries could never understand that Britain would be so foolish as to pay the debts of another country unless she were so wealthy that the money would not be missed. They would regard such an action on their part as sheer lunacy. So far as I can judge, they are not a bit grateful to us for what we have given them or what we have done for them. They accept all these things as less than a matter of course. In their minds, Britain always pays. There is an old saying that the willing horse will pull ; but in this case Britain has been behaving like a foolish ass !

It required all the bluntness of the Right Honourable Philip Snowden, the Chancellor of the Exchequer, at the Hague Conference of the Allies in August 1929, to shock them into a sense of realities. It required this same bluntness to shock British statesmen into a true understanding of how deeply the British people feel on this matter. The seemingly bovine or asinine patience with which British taxpayers submitted to the ever-increasing burdens that politicians smilingly lifted from the backs of the continental peoples and added to the back-breaking and heart-breaking loads of the British people has been misleading. Deep down, a feeling of injustice was rankling ; it was not very articulate, and it needed the firm stand of Mr. Snowden to give it tongue. All the people of Britain, irrespective of political parties, closed their ranks solidly behind Mr. Snowden to back up his demands.

On Monday, September 2, 1929, Mr. Snowden broadcast an account of what had happened at the Hague, and I cannot do better than quote from the report which

appeared in *The Times* next day. After describing how the Continental Powers under the Young Plan proposed to take a further sum of £2,400,000 out of the pockets of the British taxpayers and share it out among themselves, Mr. Snowden said: "The objections of the British delegation appeared to come as a surprise to the Conference. It certainly came as a surprise to me that the other delegates to the Conference should have been so ill-informed as to what the attitude of the British Government was likely to be. Indeed, it came out in the later stages of innumerable interviews with the heads of the principal delegations that they had never fully realized what Great Britain was expected to sacrifice. The great sacrifices which Great Britain has made in the various debt settlements with continental debtors had never been adequately appreciated. I told the Conference, when the foreign delegates talked of the sacrifices they were making, of the burdens which the British taxpayers were bearing for their benefit.

"As a matter of fact, there is not a single one of the countries that were engaged in the War that has made anything at all approaching the financial sacrifices which Great Britain has made. We have a War Debt now of £7,500,000,000, which is more than double the War Debt of any other nation which was engaged in the War. The taxation of our people is about double per head of the population of that of any other country. We have to provide, I told them, 125,000,000 francs (£1,000,000) every day of the year for the service of our War Debt.

"I had to remind them also of the generous and magnanimous character of our debt settlements with our late Allies. We had settled a debt owed to us by France of £600,000,000 for £227,000,000. In the case of Italy we settled a debt of £500,000,000 for a present value of £78,000,000, and, if the proposals of the Young Report were carried into effect, we should have to sacrifice to Italy another £30,000,000. In addition to all these sacrifices, which placed a permanent burden of £60,000,000 a year on the British taxpayer, we were now

asked by the terms of this Report to sacrifice a further £2,400,000 a year.

" ' The limit of concession has been reached,' I said. ' I am as anxious as any member of this Commission to come to an agreement which would be mutually satisfactory, but there can be no settlement unless it is a settlement based on justice. It is not merely a question of some £2,000,000 a year. It is more than that. It is a claim for the maintenance of international agreements, for fair dealing between nation and nation. We have been asked to look at this question from the wider view of the pacification of Europe. We do that. Great Britain has made unparalleled sacrifices for that purpose, but the time has come to say that other nations must make their contribution to this desirable object, and we cannot any longer agree that every step forward in European construction should be made at the expense of the British taxpayer.' This frank assertion that Great Britain was determined to assert her just rights fell like a bombshell on the Conference."

Discussion followed discussion, with M. Jasper as an intermediary every time bringing a little more, but not enough to satisfy our just claims.

" M. Jasper was in despair," continued Mr. Snowden. " ' I cannot do more,' he said ; ' you have emptied all our pockets.' ' Go through your pockets again,' I said very kindly, ' and I am sure that you can find enough to cover what remains between us.' "

They did.

" It has been commonly asserted in the foreign Press that the British delegation were fighting only for some sordid material gains," added Mr. Snowden. " It is quite true that we were determined that our just rights in the matter of the distribution of reparations should be respected. These were by no means unimportant, although a sum of £2,000,000 a year is an infinitesimal part of the enormous sacrifice which this country has made for the benefit of our continental debtors. When we decided to resist the call for further sacrifice we

desired the world to know that we could not allow Great Britain any longer to be regarded as the milch cow of Europe.

"But beyond this, and of far greater importance, was our assertion of our international rights and our determination that international agreements should be respected. I am convinced that our stand will make a profound impression on our future relations with the other countries of Europe. The rights and the influence of Great Britain in international diplomacy have been reasserted, and there will be no reversion to the spineless policy of recent years. We have won the respect of the nations with whom we have been in acute, but friendly, controversy in the past four weeks. I made it a condition at the outset of the Conference that Great Britain would not accept any concession to her just claims at the expense of the smaller Powers or Germany. This condition has been maintained. After the final agreement had been reached I voluntarily sacrificed some share of the unconditional annuities to which we were entitled in order that they might be divided among the smaller nations, and this concession has won for us their ardent gratitude and respect. Throughout the Conference the personal relations between the British delegates and those of the other Powers have been of the most cordial and friendly character—a striking contrast to the bitterness of the personal attacks which have been made on me in some of the continental newspapers. One of the mildest characterized myself as the reincarnation of the man who burned Joan of Arc, beheaded Mary Queen of Scots, and banished Napoleon!"

By pleading that they were too poor to pay, the French politicians have compelled the British taxpayers for the next half a century to pay taxes on French debts which should and could be paid by French taxpayers. By depreciating their currency they have confiscated at least four-fifths of the money lent to them by Britons, and have reduced many of our people to poverty. Not content to take advantage of the British in this respect,

they now seek to hold up Britain as a horrible example of a State where taxes and unemployment are steadily increasing, with its difficulties in India and elsewhere, a State which is floundering—if not foundering—in a sea of troubles. By the side of these posters, which appeared in Paris in May 1930, others dwelt on the prosperity of France, with no unemployment, no troubles in foreign possessions, and taxation steadily growing less ; while instead of a deficit on the Budget, as in Britain, there was a big surplus in the French Exchequer.

Having done more than any other nation to bring us to our present deplorable condition, the French politicians do not scruple to use our troubles to further their own political ends. These posters were not only an insult to the generosity of Great Britain, but they definitely proved more than the Frenchmen intended—that when the French diplomatists were pleading that France could not afford to pay, their pleas were not in accord with the facts as disclosed by their own Budget.

In taking his stand at the Hague, the Right Honourable Philip Snowden served Britain well. He sought to impress on the Powers how much they owe to this country in actual cash, quite apart from the predominant part we played in the Great European War.

My own personal aim in writing this book is far wider and deeper and higher. I have striven, in addition, to show how much the whole world and civilization in general owes to Britain for many of the material comforts enjoyed to-day, and for many of those humane and noble ideas which seek to make Liberty, Equality, and Fraternity not merely an idle formula to be mouthed by those whose intent is to destroy, but a living force among those who labour to create a new world wherein Peace shall dwell with Honour, and Justice and Mercy shall go hand in hand.

CHAPTER XXI

HONOUR WHERE DUE

A LIFETIME is far too short to describe all that Britain has given to humanity. In the nature of things it must be so. New discoveries continually arise, and within the past few months an English youth has invented an apparatus for detecting dangerous gases in mines—an invention which may bring to miners the world over a measure of safety hitherto unknown—yet I can do no more than devote these few words to it.

Even the wide subject of the sporting instincts of our race must be dismissed with scant justice. On the whole the British are a nation of sportsmen, open-air people who play their games for the sheer joy of them. They have taught the world to row and play lawn tennis, they have carried Rugby and Association football abroad, they have revealed to other peoples the exasperating conditions of golf, which school the mind to patience and bring health and rhythm to body, hand, and eye.

Hunting, walking, shooting have all done something towards moulding the race, and those outdoor pursuits which are so much a part of us have taught us to try to play the game and to exercise magnanimity toward our rivals. In awakening the sporting instincts of other nations, Britain has opened up for them unbounded pleasure ; and by the time another generation or two have learned to play their games fairly and without rancour, it seems reasonable to hope that a wider tolerance and a stronger spirit of goodwill may develop among them.

That our foreign pupils beat us is no sign of our decadence. America, for instance, has carried off our golf championships, but consider the facts. With a nation three times as large as the British nation, America has three times as many men from whom to select her champions. The grass of Flanders covers those who might have been our present champions, whereas the War barely touched the flower of American manhood. And as the vaults of America are stuffed with British gold, and money makes champions and attracts foreign champions to settle, I wonder not that America wins, but that she ever loses.

Yet the United States in all her power and might must take second place when it comes to broadcasting. Despite all the criticism that may, with justice, be levelled at the British Broadcasting Corporation, its services are second to none, and this island, which made broadcasting possible, has provided a model institution for other lands.

Nor may I close without touching on another mighty force which, in the hands of the right men, is a marvellous power for good—in the grip of the wrong, a most sinister evil. Those who produce pictures may make or break nations, but Russia alone seems fully cognisant of this. It is as well for Britain that the American film magnates have been imbued with but one aim, to amass wealth ; for, with control of the film screens of the world for one half the time that America has dominated them, I could have changed the face of the earth.

The ability of all nations has been bought to build up the reputation which America enjoys, and if, from that Realm of Unreality wherein cinema stars and magnates dwell, we derive the impression that the country which rules the cinema industry was also responsible for the initial invention which founded it, we may be forgiven our error. Let us in the first place accord full credit to Lumière of France, Jenkins of the United States, and Skladanowsky of Germany, whose patents of 1894 and 1895 show that they had independ-

ently solved the problem of moving pictures. But these inventors were years behind the late William Friese-Greene who, of all the workers in this sphere, was the man who made possible the commercial cinema which now delights its millions. That claim, which can be fully substantiated, is no less than the truth; for Friese-Greene not only invented the first practicable camera to take moving pictures and made with his own hands the first celluloid film on which moving pictures were taken, but he also invented those sprocket holes at the side of the film by which movement is given to the pictures, and then showed the pictures in an enlarged form moving on a screen so that many people could view them at once. His genius solved the whole problem, and his patent (No. 10301) is dated June 21, 1889, at which time he had been working some years on the subject. That same year, and early in 1890, the *Saturday Evening Post* and the *Scientific American* published full descriptions of Friese-Greene's marvellous invention throughout the United States, while all the leading English newspapers also published accounts of it.

The famous Edison himself, who produced his kinetoscope in 1891, and sought to patent the sprocket holes at the side of the film, was obliged to give precedence to the Englishman; for when Edison's claim came before the American judges, the American Supreme Court upheld Friese-Greene's invention under the patent of 1889 as embodying the master patent of the world for commercial cinematography. That fact alone sets all doubts at rest as to who is entitled to the honour of giving the world moving pictures.

To the many instances in history of two men working on the same problem at the same time and arriving at the same results, cinematography adds another case. While Friese-Greene was overcoming his difficulties in London, Augustin Le Prince was progressing along identical lines in Leeds, and in January 1888 he was actually granted a patent for taking moving pictures on gelatine film; he, too, worked out the idea of moving

the pictures by means of sprocket wheels whose teeth fitted into holes at the margins of the pictures, although Friese-Greene was before him in this respect. One of the unsolved mysteries is what became of him, for in September 1890 he said good-bye to a friend on the Paris train and simply vanished. Not a single trace of inventor or inventions was ever found.

Le Prince undoubtedly solved all the essentials but one. That one was the celluloid film, and this was the final and most important discovery of Friese-Greene, the real master-key of commercial cinematography. Unfortunately you may consult reference books in vain for any mention of its inventor. He and his works are alike unknown, and I was so baulked in my attempts to discover the truth that the whole matter seemed to challenge me to find out anything at all. Defeated here, snubbed there, learning nothing elsewhere, writing letters that were never answered, telephoning in vain, I listened one day to a voice on the telephone, and knew that my search was at an end.

Born at Bristol in 1855, Friese-Greene won his way to Cambridge University, and after coming into contact with Fox-Talbot, who helped to make photographic history, he was, in conjunction with Mr. Rudge of Bath, in 1883, photographing movement on circular glass plates. By January 1888 he succeeded in producing a continuous series of moving pictures on a band of sensitized paper, which he rendered partly transparent by dipping it in castor oil, and imparted movement to it by punching along each margin a series of holes into which the teeth of sprocket wheels would fit to shift the photographs automatically as the wheels turned.

Recollection of some experiments with celluloid carried out with Alexander Parker, who invented this product in 1865, gave Friese-Greene the final impetus towards success. Obtaining some crude celluloid which was nearly opaque, he spent months in his attempts to render it clear. He struggled on, thinking only of his quest. Failure cast him down, but left him unbeaten.

One day he shut himself up in his room and utterly lost himself in his task. All that day, and the next, and the day after, he worked like one demented. The door of his room remained closed on him. If he slept at all, it must have been for short periods in his chair. Food was brought to him and carried away again almost untouched. Kettles boiled ceaselessly on the fire, and to keep them boiling he used up all the coal he had, all the wood. Then, like Bernard Palissy, the famous potter of old, in the crisis of facing failure owing to lack of fuel, he tore up the very floorboards to keep the fire going, and, after being immured in his room for a week, his tired eyes gazed on some clear celluloid film, and he knew he had solved the last problem of all.

Cutting the film into strips, he set up his camera at Hyde Park Corner in October 1889, and took the very first real moving picture on celluloid film—one of those historic pictures illustrates this book. That film, along with all the documentary records and apparatus belonging to Friese-Greene, might also have vanished for ever but for the tenacity of Mr. Wilfred Day, F.R.P.S., F.R.S.A., who has spent a fortune unravelling the beginnings of the cinematograph, and whose wonderful collection of apparatus is now on loan at South Kensington Museum, London. I owe thanks to Mr. Day for this information concerning the man who gave us moving pictures.

In 1890 Friese-Greene amazed his contemporaries at the Photographic Convention in the Town Hall at Chester by showing them the film he had taken in October 1889, and by projecting the moving pictures upon a large screen. They saw the figures move on the screen, watched them walking across the road at Hyde Park Corner, and could hardly believe their eyes. Also in that very year of 1890, Friese-Greene was actually commissioned by the War Office, at a fee of five guineas per day, to go up in a balloon and take moving pictures of troops on manœuvres, which service he performed to the entire satisfaction of the military authorities, as a letter I have seen from the War Office proves.

AN ENLARGEMENT FROM THE FIRST MOVING PICTURE EVER FILMED. IT WAS TAKEN BY W. FRIESE-GREENE IN 1889 AT HYDE PARK CORNER, BUT INSTEAD OF THIS ENGLISH PIONEER, WHO GAVE THE WORLD CINEMATOGRAPHY, MAKING A FORTUNE OUT OF HIS INVENTION, HE DIED IN ABJECT POVERTY

In the Wilfred Day collection, moreover, is a publication, dated 1889, in which the editor enthuses about Friese-Greene's invention of moving pictures, and mentions the inventor's idea of wedding his moving pictures to the phonograph which Edison had invented. Among the documents in the same collection is a copy of a letter from Friese-Greene, written to Edison in 1890, asking if the American inventor would grant an interview if the Englishman visited New York, as he had something to discuss with him. That interview did not take place, but Friese-Greene in after years mentioned that he wished to discuss the synchronizing of the phonograph with the moving pictures; so from the very beginning the English genius visualized the whole problem of talking pictures, and saw one way of solving it.

America, indeed, which is defiling the well of pure English with her "talkies," was by no means the leader in that field; for as far back as December 1908 Mr. Cecil Hepworth made his application for a patent for speaking films, which patent was duly granted, and I happen to be one of those who received an invitation to attend the first demonstration. That early demonstration of synchronizing a gramophone disc with a film was far better than some of the early American talkies which outraged my ears, but it lacked the volume of sound which the present loud speakers give.

Hepworth is another of the pioneers of cinematography who has not been accorded the full credit that is his due. Years ago he told me of the thrill he felt when he took his first moving picture of an express train, and how he filmed the Derby from the top of an omnibus before this century dawned. Seeking something in the days when all films consisted of one scene just fifty feet long, he made film history by being the first man to produce a picture of several scenes; it was a burglar comedy of over 300 feet in length, and its success led him to produce other and longer comedies for which America simply clamoured. Would that it were the same to-day. Mr. R. W. Paul must also be mentioned

as the English pioneer whose invention, engaged for one week to project moving pictures upon a screen at the old Alhambra Theatre in London, went on projecting them for years.

Poor Friese-Greene! He little knew, as he turned the handle of his camera in Hyde Park Corner in 1889, that his short film was destined to found an industry which in the ensuing forty years would assume such gigantic proportions in the United States that the capital invested in it would amount to £400,000,000, while there would be 20,000 American cinemas paying £50,000,000 a year to hire films which cost £25,000,000 to produce; and that the whole world would have invested in the industry in the year 1930 the sum of £750,000,000. The cinema industry, with its vulgar and strident voice, has done much to rob superlatives of their value, but the growth which has sprung from that first film of Friese-Greene may be truly described as colossal.

High above all film romances towers the tragedy of this genius who started the industry which poured millions into the pockets of others and brought nothing but disappointment and penury to himself. Occasionally he was almost starving, glad to borrow enough to buy a crust of bread and cheese; the next day a friend might raise for him £100 or £200, and he would be seen having a banquet in the best hotel; and within a short time all his money would have disappeared—he could not tell you how, it just went. He would pay outstanding debts, buy new materials for new experiments, and then wake up penniless once more.

Finding the Friese-Greene children in bed one afternoon, Mr. Wilfred Day asked the reason.

"They've no shoes to their feet," said Mrs. Friese-Greene.

Mr. Day provided the shoes, and in the last year or two provided the necessaries of life for the inventor. There was a time when Friese-Greene was imprisoned in Brixton for debt. Think of this genius, who in his later days brought colour as well as movement to the screen,

going to prison because he could not pay his way. His inventions should have made him a millionaire, but he was a dreamer through whose fingers the money slipped, for whom money seemed to have little significance.

Denied the recognition that he had earned, lacking the royalties which ought by right to have flowed in to him, he battled on and strove to press his claims, working away at his new colour invention despite all the other disappointments. Then on May 5, 1921, the leaders of the film trade of Great Britain forgathered in the Connaught Rooms in London to honour Friese-Greene at last for what he had done, and also to try to arrange some financial recognition of his great work. The inventor rose to speak, to voice his thanks, suddenly collapsed on the floor—and expired instantly.

The verdict was heart-failure—but if ever a man died of a broken heart it was Friese-Greene. Poverty and neglect dogged him to his death. But those interested in the film trade have since erected a beautiful white marble memorial over his grave in Highgate Cemetery. So, buffeted by Fate, a genius passed away, and I hope these few words will help to bring renown to his name.

CHAPTER XXII

GLORY WITHOUT END!

ON the map of the world Britain is a tiny spot that could so easily be overlooked—but for one thing. The map-maker seems to have amused himself by drawing dotted lines from the outer margins of the map, all curving and converging on one point: they are the steamship routes, and from the ends of the world they lead to Britain, and go to prove the old saying that all roads, whether they be sea roads or land roads, lead to London. But to me they are something far more than the roads the proud liners and cargo carriers take in their goings and comings; they serve to show the lines along which the culture of these islands has reached out to the uttermost confines of the earth. In themselves these lines are the symbol of the Greatness of Britain.

Think for a moment of the wonders carried over them: the power of the steam-engine, the railway, the steamship; the tenacity of steel and cement, the illuminating qualities of gas and electric light, the force of the steam-hammer, which was visualized instantaneously down to its last detail by Nasmyth and the plan drawn in half an hour.

Material things! you cry. Yet without material things the world would die. And when I range in my mind over the material comforts which Britain has given to the world, they seem to stretch into infinity.

There are other things, higher things: ideas that foster truth and justice in life, forms of government that aim to make existence bearable for all, the spiritual comfort bestowed on the world when Tyndale of the flaming zeal began to unlock the beauties and wisdom of

the Bible by translating it into English in the very teeth of the opposition of Rome, and was burned at the stake as a heretic. Who can measure the good that he and Coverdale and those who gave us the Bible did for humanity? They flung the word of freedom in the face of tyranny, and those who died for their ideals lit a torch which still flames on, although for the moment the glow may appear to be diminished.

Why should so small a land have produced such giants of thought? Why should Britain have bred those geniuses who have done more than all the rest of the world together to shape and mould modern civilization? Are we indeed the chosen people of the Bible, as so many people think?

> "The moving finger writes; and, having writ,
> Moves on: nor all thy piety nor wit
> Shall lure it back to cancel half a line,
> Nor all thy tears wash out a word of it."

Can we see, as in a glass darkly, the moving finger writing to explain why Britain is great? When I sat down with the first clean sheet of paper before me it was to tell of the Greatness of Britain, to touch on those achievements that are the glory of our race, and not to give the reason why so much talent should flow from the land in which we dwell. Now, perhaps, it may not be amiss of me to touch briefly on the reason, as I see it.

Nature herself has conspired to make Britain what she is. She has endowed these islands with a fecund soil and a climate of rain and sunshine which is the very soul of growth. She has dropped in a sea of silver this jewel which only the strong and brave could attain after battling with the forces of the sea. In days of old, when the British race was in the making, only the best men could set foot on these islands: vital men breed a vital stock, and herein lies in part the secret of Britain's unprecedented greatness.

The Anglo-Saxon race is the biggest mixture of races the Old World ever knew. All bloods run through our

veins. And the point of the highest importance is that it is not the worst blood of other races that was infused into us, but the very best blood. These beautiful and fertile lands of ours were as a paradise to those hungry peoples on the barren soils at the other side of the North Sea. In those times England was in very truth a land where heroes dwelt, for only heroes might reach our shores. The land beckoned. It was a prize beyond all conception. And the peoples came.

Our English forefathers were pirates of Teutonic strain. The strong and resourceful survived the hazards of sea and sword, the weaklings and slow-witted succumbed. Other powerful and lusty pirates from Norway and Denmark raided the land, and returned later to settle and mix and blend, where the Romans had lived and blended before them. Scots and Picts, Angles and Saxons, Romans and Normans and Celts and others, such is the mixture of which we are compounded. The warriors who raided the East Coast and helped to create our race were enterprising and courageous beyond their fellows, and their strain still runs through us and influences us despite the centuries that have elapsed. The Greatness of Britain has been built up on new blood and more new blood. Eugenists can point to the British race as the living proof of their beliefs. Nature herself carried out in these islands the most marvellous experiment in practical eugenics: she fixed her barriers, which selected only the best and rejected the second best, and the result is plain. In America to-day the same merging of races is going on, and if natural selection means anything at all, the one outstanding lesson it teaches is that in due course there, too, will emerge a brilliance tending to outshine that of the other races.

But the strength of Britain for the future lies in the fact that she is reproducing overseas in new lands new British races that spring from the best and most enterprising of her stock, and this is why I believe that, if but the unity of the Empire family be fully preserved and developed, her past and present greatness will seem

small when compared with her greatness in the years to come.

Take heart, O ye of little faith! Britain's day is but begun. The same spirit which forced King John to give us liberty and justice still animates the breast of every Briton. Although we bend under burdens which should rightly be borne by others, we may not, shall not, break. The miracle of 1914–18 proves it; the spectacular massing of all classes during the general strike of 1926 to defeat those Labour leaders who thought themselves strong enough to override the Constitution proves it; a united people backing Mr. Philip Snowden at the Hague proves it. Under the froth of politics is the silent strength of the nation; ripples of movement such as those which animate the muscles of an athlete are faintly discernible; the people themselves are beginning to stir to deal with that economic menace which threatens us from without.

The New Age is here. Already Great Britain has stamped it with her genius. Not for nothing is she called Great. English brains and hands have designed and shaped and driven the speediest things in air, on water, and land; they have conjured gossamer silk out of wood chips, have found the magic lamp which steals music out of the silent ether, and have snatched the invisible images of people out of space and set them singing and acting on the screen.

Many other things have they done, of which I may not write. For this book must end. But of the Glory of Britain there is no end. It shines out each day anew like a rising sun, and gleams with a refulgence which illumines the whole earth.

INDEX

Abercromby, Sir Ralph, defeats French in Egypt, 297.
Aboukir Bay, battle of, 297, 299.
Adams, Professor, discovers Neptune, 233–234.
Admiralty and submarine campaign, 318.
  objects to propellers, 39.
  rejects Wilson's propeller, 42.
Africa crossed by Livingstone, 192.
Air raids prophesied, 312.
  speed records, 67.
Alcock, Sir John, makes first Atlantic flight, 65.
Alexander, Canon S. A., 10.
American States repudiate their debts, 333.
Amiens, Peace of, 275.
Amundsen and North-West Passage, 198.
  and Scott, 206–207.
Anæsthetics first used, 157–158.
Antisepsis discovered, 159, 160.
Archæology, 168–179.
Argon discovered, 239.
Arkwright invents the spinning-frame, 100–103.
  sues Colonel Mordaunt, 103.
Armada, Spanish, defeated, 292–294.
"Arrow, Golden," 66.
Artificial silk, its romance, 109–118.
    first invented by Sir Joseph Swan, 112–114.
    process of making, 118.
    viscose process, invented by Cross and Bevan, 114.
Assuan dam and stainless steel, 87.
Assyria, Layard's discoveries in, 174–176.
Atlantic cable, the first, 132.
Atlantic, first wireless signals received, 139.
  flights, 65.
Atrocities, 308.
Austin "Baby" cars, 63.
Austin, Sir Herbert, 62.
Australia, Burke and Wills explore, 190.
  colonized, 189.
Ayrton, Professor, and Royce, 55.

Babylonia and Layard, 174–176.
Bach, 210.
Bacon, Roger, 232.
    his wonderful prophecy, 53.
Baden-Powell, Lord, 289.
Baffin, William, 198.
Baird, J. L., and television, 141–148.
Bakewell, Robert, stock-breeding experiments, 245, 246.
Balfour Memorandum to cancel debts, 325.
Banbury, Lord, on American default, 333.
Banks, Sir Joseph, and steamships, 35.
Barrie, Sir James, 132.
Basic steel, 78–81.
Beethoven, 210.
Behistun, Rock of, 172.
Bell, Alexander Graham, invents telephone, 134–135.
Bell, Henry, and steamships, 35.
Benn, Wedgwood, on India, 273.
Bennett, Arnold, 226.
Benz, Karl, 53.
Bernstorff, Count, 318.
Bessemer's discovery, how made, 77.

Bessemer, Sir Henry, invents cheap cast steel, 75.
Bevan, E. J., invents viscose silk, 114.
Biffen, Sir Rowland, and new wheats, 250.
Birkenhead, Lord, on British War efforts, 326.
Bishop, 211.
Blake, Admiral, and van Tromp, 295.
Blood, circulation of, 150.
Blucher, General, 304.
Bolckow, Vaughan, 80.
Boulton and Murdock, 16.
  employs Murdock, 124.
  prevents Murdock patenting steam locomotive, 18.
Boulton, Matthew, and Watt, 16.
Boyle, Robert, 14.
Brazil, Emperor of, and first telephone, 134.
Brearley, Harry, discovers stainless steel, 86.
Brett and first telegraph cable, 131.
Bridge, the first iron, 70.
Bridgewater, Duke of, and steamships, 34.
Britain, beauties of, 11.
  holds land and air speed records, 68.
  makes modern Egypt, 7.
  why she is great, 349–351.
British Admiralty and submarine campaign, 318.
  airships, R 100 and R 101, 65.
  Army in War, total, 324.
  Empire, romance of, 261–279.
  engineering miracles, 71.
  Expeditionary Force landed, 309.
  financial losses through depreciated franc, 6, 331.
  inventions, 348.
  Israelites, 278.
  Navy saves the world, 306.
  race, origin of, 350.
  railways amalgamate, 26.
Britons disliked by French, 5.
Broadcasting, 341.
  how brought about, 137–141.
Brooklyn Bridge, 70.
Brown, John, and first steel rails, 84.
Brown, Sir A. W., makes first Atlantic flight, 65.
Bruce and Everest, 202.
Brunt, Dr., and trench fever, 165.
Burke and Wills explore Australia, 190.
Burns, Robert, 227.
  the poet, sees first steamship, 31.
Burton and Speke, 195.
Byrd, 211.

Cable, the first telegraph, 131.
Calcutta, Black Hole of, 268.
Canada, wheat yield in, 249.
  won by Wolfe, 264.
Cantlie, Sir J., 150.
Cape Colony and Britain, 274–278.
Carding-machine invented by Hargreaves, 94.
Carnarvon, Lord, and Tutankhamen, 178.
Carron Iron Works, builds engine for first steamship, 31.
Carter, Howard, and Tutankhamen, 178.
Cartwright, Edmund, invents the power-loom, 103–105.
Castlerosse, Viscount, 332.
Cavendish, Henry, his scientific work, 236.
Celanese silk, 117.
Celluloid invented by Parker, 343.
Cement, its invention, 71.
Challoner, G., 78.
Champollion, 170–171.
Channel tunnel, cost of, 29.
Chardonnet, Count, and artificial silk, 114.
Charles the First and Harvey, 151.
Chaucer, 218.
Child slaves, 286.
Chloroform, first experiments with, 156.
Churchill, Winston, and Navy, 310.
Cinema statistics, 346.
  pioneers of, 341.
Cinematography invented by Friese-Greene, 342–345.

Circulation of blood, 150.
Claremont, Mr., and Rolls-Royce, 57.
Cline, Henry, and vaccination, 154.
Clive wins India, 266–269.
Clynes, Right Hon. J. R., 287.
Coal-tar dyes discovered by Perkin, 119–120.
Coherer and wireless, 139.
Collodion, its many uses, 111.
Constable influences French art, 215.
Cook, Captain, 188–190.
his discoveries, 189.
Cooke and electric telegraph, 130.
Copenhagen, battle of, 300, 301.
Cordite, 241.
Cortez, 181.
Cotton industry boom and collapse, 105–108.
Courtaulds found viscose silk industry, 117.
how they were interested in viscose silk, 115.
Crete, excavations in, 179.
Crimean War scandal, 165.
Cromer, Lord, 8.
Crompton, Samuel, invents the spinning-mule, 96–100.
Cromwell and the Jews, 281.
Crookes, Sir William, 136, 137.
attains high vacuum, 240.
Cross and Bevan invent viscose silk, 114.
Cross, C. F., invents viscose silk, 114.
Cuneiform translated, 171–174.
Curie, Madame, 122.
Cut finger leads to blasting gelatine, 112.

Daimler, Gottlieb, 53.
Daimler, his first motor vehicle, 54.
Dalton and atomic theory, 235–236.
Dampier, adventures of, 185–187.
Darius, his inscription read, 174.
Darwin publishes *Origin of Species*, 257–260.
Davis, John, and Davis Strait, 198.
Davy, Sir Humphry, and Faraday, 125, 126.
and first arc-light, 148.
and laughing gas, 157, 158.
his discoveries, 234, 235.
Dawson, Charles, discovers Piltdown skull, 255, 256.
Dawson, Lord, and Hickman, 159.
Day, Wilfred, and cinematography, 345.
and television, 144.
Debts repudiated by American States, 333.
Del Cano, 183, 184.
Delius, 212.
Dewar, Sir James, and cordite, 241.
invents vacuum flask, 243.
liquefies oxygen, 242.
low temperature experiments, 242.
Diesel oil-engine, 44.
Discoveries in medicine, 149.
Disraeli, 1.
and Reform Bill, 284.
"Dole," its drawbacks, 9.
its influence on race, 283.
D.O.R.A. curtailing liberty, 284.
Dornier Do X, 64.
Dover, Dr., and Dampier, 187.
Drake and the Armada, 292–294.
his expeditions, 180–185.
sees Pacific Ocean, 182.
Dreyfus, Dr., and Celanese silk, 117.
Dudley, Dud, discovers new smelting process, 75.
Dundas, Lord, backs Symington's steamship, 32.
Dunlop, J. B., and pneumatic tyre, 59–62.
Dye industry, 118–120.
Dyes, coal-tar, discovered by Perkin, 119–120.
Dynamo, 127.

Eckener, Dr., 65.
Eddystone Lighthouse, 71.
Edison and electric lamps, 137.

Edison and electric light, 121.
and Friese-Greene, 345.
and phonograph, 135.
Egypt and Britain, 273.
irrigated by Britain, 71.
modernized by Britain, 7.
Egyptology, 177–178.
Electric light invented by Swan, 122.
telegraph invented, 129.
Electricity, Father of, 127.
Electrons discovered, 240, 241.
Elephantiasis, 161.
Elgar, Sir Edward, 211–212.
Elizabeth knights Drake, 184.
Encephalitis lethargica, 155.
England, wheat yield in, 249.
Ericsson and propellers, 39.
Eugenics, the greatest experiment of all, 350.
Evans, Petty-Officer, 207.
Evans, Sir Arthur, and Knossos, 178–179.
Evans, Sir John, 254.
Everest Expedition, 201–203.

Faraday accepts pension, 128.
and Davy, 235.
discovers power of ether, 158.
his career, 125–128.
his electrical discoveries, 127.
preserves Davy's notes, 128.
Fertilizers, 246.
Finch and Everest, 202.
Firth & Sons and stainless steel, 86.
Fitch, John, and steamship, 31.
Fleming, Sir J. A., and electric lamps, 138.
and wireless telephony, 137.
Ford, Henry, 58, 122.
and mass production, 63.
mends watches, 22.
Forest, Dr. Lee de, and wireless, 140.
Forth Bridge, 70.
Fox, Dr. C. J. J., and first viscose silk, 115.
France, debt to Britain, 328.
depreciates her currency, 330.
proves too much, 339.
Franklin discovers North-West Passage, 200.
his last expedition, 199.
French dislike Britons, 5.
Government moves to Bordeaux, 310.
loans in London, 331.
Revolution, 295, 296.
Frere, John, 253.
Friese-Greene invents cinematography, 342–345.
is imprisoned for debt, 145.
Fulton, Robert, and steamships, 35–36.
Fulton's steamships derived from Symington's, 36.

Gainsborough, 214.
Galileo, 231.
Gallipoli, 314.
Galsworthy, 226.
Galvanometer, 132.
Gaslight discovered by Murdock, 124.
Geneva Convention signed, 166.
George, Mr. Lloyd, and State Insurance, 282.
forms Ministry of Munitions, 313.
German atrocities, 308.
Navy scuttled, 319.
surrendered, 319.
spies caught, 309.
Germans use gas, 315.
Germany depreciates her currency, 330.
Gilbert, Sir Humphrey, and Newfoundland, 278.
Gilchrist, Percy Carlyle, and basic steel, 80.
" Golden Arrow," 66.
Grant and Speke, 195.
Grasses, breeding new, 247.
Gravitation, 230.
Great Britain's destiny, 350.
War armies, 324.
Great War, early days of, 310, 311.
its cause, 307, 308.
and Austria, 306.
Greathead builds City and South London Railway, 26.

Greene, Friese-, imprisoned for debt, 145.
Grenville, Sir Richard, and Spanish Armada, 292.
Grey, Sir Edward, and peace efforts, 308.
Grogan and Sharp traverse Africa, 195–197.
Gurney, Sir Goldsworthy, and steam-cars, 50–52.
and Stephenson's steam blast, 24.
petitions Parliament, 52.

Hadfield, Sir Robert, 81–85.
Hague, Snowden at the, 335–339.
Halley and Newton, 232.
Halliwell, P. V. C., dies with Segrave, 46.
Hamilton, Lady, and Nelson, 303.
Hancock runs first steam-buses, 52.
Handley Page, Father of giant aeroplane, 64.
invents safety-slots, 64.
Hardy, Thomas, 226.
Hargreaves, James, invents spinning-jenny, 93–96.
attacked by mill-hands, 95.
invents carding-machine, 94.
Harvey, William, discovers circulation of the blood, 150, 151.
Hatfield, Dr., develops an everbright steel, 87.
Hathaway, Anne, 220.
Hawkins, Sir John, 181.
Hayes-Sadler, Captain, 197.
Helium discovered, 239.
Helmets of manganese steel, 85.
Hepworth, Cecil, and early talking films, 345.
Hertz, 233.
Hickman, Henry, and anæsthetics, 158.
Hieroglyphics first translated, 168–171.
Hill, Sir Rowland, and Postal Reform, 288.
Hooke, Dr. Robert, and artificial silk, 110–111.
Hooker, Dr., and Darwin, 259.
House of Commons and steam traction, 51.
Howard, Lord, and Armada, 292.
Hughes, David E., invents the microphone, 135.
his charitable bequests, 136.
Hughes, E. J., and artificial silk, 111.
Hughes, Professor, first wireless signals, 136.
Huntsman, Benjamin, invents crucible steel, 73.
Huxley and wireless experiments, 136.
defends Darwin, 257.
Hydrogen solidified, 242.

India and Lancashire, 106–108.
irrigated by Britain, 71.
unsettled conditions, 7.
Indian Empire, romance of, 265–273.
Industrial age, 244, 245.
Inner Circle railway, 27.
Iron first smelted with coal, 75.
Irvine and Everest, 203.
Irving, Captain, designs fastest car, 68.
Italy, debt to Britain, 328.

James, Thomas, assists Hargreaves, 95.
Jameson Raid, 276.
Japan and Lancashire, 107–108.
Jasper, M., and Mr. Snowden, 337.
Java skull, 255.
Jazz, 209.
Jenner and small-pox, 152–155.
awarded £10,000, 154.
Jews in England, 281, 285.
in Parliament, 285.
Jonson, Ben, 220, 224.
Jutland, battle of, 315, 316.

Kay, John, attacked by weavers, 92.
dies in poverty, 93.
invents fly-shuttle, 91.
Keats, 227.
Kelly, William, 78.

Kelvin and Atlantic cable, 132.
and first telephone, 135.
his career, 133.
his many inventions, 132.
Kepler, 231.
Kew Gardens and rubber industry, 60.
Key industries, 307.
Kinkead, Lieut. S. M., 68.
Kitchener creates British Army, 310.
Kluck, von, 319.
Knossos, excavation at, 179.
Knutsford, Viscount, on bad old days, 155.
Kreisler and Elgar, 211–212.

Lancashire and Free Trade, 107.
and India, 106–108.
and Japan, 107–108.
cotton industry, a propheey, 106–107.
pays tariffs, 108.
robs Kay, 93.
the post-war boom and collapse, 105–108.
Lancashire's only hope, 108.
Langton, Stephen, 286.
Laughing gas, Davy first tries, 158.
Lawes, Sir John, 252.
Lawrence of Arabia, 271, 314.
Layard, Sir Henry, and excavation, 174–176.
League of Nations formed, 320.
Lenoir, Etienne, 53.
Levassor acquires Daimler engine rights, 54.
Leverrier discovers Neptune, 234.
Lewis and filaria, 161.
Lichnowsky, Prince, blames Germany for war, 321.
Lister, Lord, and antisepsis, 159, 160.
Livingstone, adventures of, 191–194.
Lloyd George forms Ministry of Munitions, 313.
Locomotive patented by Trevithick, 19.
London and first steam-buses, 51.
beauties of, 10.
London, Fire of, 213.
passenger services, 27.
statistics, 27.
Lovelace, 224.
Lusitania torpedoed, 317.
Lyell, Sir Charles, 255.
and Darwin, 259.

Macaulay on British Rule in India, 269.
MacDonald, Right Hon. J. Ramsay, and British burdens, 332.
Machinery and population, 244.
Macmillan and first cycle, 62.
M'Nee, Dr., and trench fever, 165.
Magna Charta, 280.
Magnetic detector invented, 139.
Malaria and Sir Ronald Ross, 163, 164.
Mallory and Everest, 201–203.
Man, ancient, 254, 256.
Manby, Aaron, builds first iron steamship, 37.
Manganese steel for helmets, 85.
invented by Hadfield, 81.
remarkable properties of, 83.
Manville, Sir Edward, and television, 141.
Marconi and wireless, 137.
bridges Atlantic by wireless, 139.
Markus, Siegfried, 53.
Marne, battle of, 319.
Martin, E. P., 80.
Mary Queen of Scots, execution of, 291.
Mawson, adventures in Antarctic, 204–206.
Maxwell, Clerk, 128, 233.
Medical miracles, 149.
Melbourne, Lord, and Faraday, 127, 128.
Melchett, Lord, 243.
Mendeleeff, 238.
Meredith, 226.
Mertz and Mawson, 205.
Microbes discovered by Pasteur, 159.
Microphone, 135.
Miller, Patrick, and first steamship, 31–32.

Milton, 224, 225.
Ministry of Munitions formed, 313.
Miracles of the New Age, 351.
Mitchell designs fastest seaplane, 67.
Montfort, Simon de, and first Parliament, 286.
Mordaunt, Colonel, and Arkwright, 103.
Morgan, Pierpont, 214.
Morgan, Professor J. H., and atrocities, 308.
Morris cars, romance of, 63.
Morris, Sir William, 63.
Morse and electric telegraph, 131.
Motor Age, dawn of, 54.
Motor-buses, the first, 57.
Motor-cars, invention of, 49–63.
Murder popularizes telegraph, 130.
Murdock awarded Rumford Gold Medal, 125.
  employed by Boulton, 124.
  gives the world gaslight, 124.
  invents steam-locomotive, 18.
  the wage of a genius, 16.
Music, 210–212.

Napoleon and Faraday, 126.
  defeated and exiled, 304, 305.
  in Egypt, 297.
Nasmyth and steam-hammer, 348.
National Debt, 325.
Natural selection, 257–260.
Naval Conference, 323.
Neanderthal man, 255.
Nelson and steamships, 35.
  at Aboukir Bay, 297, 299.
  at Copenhagen, 300.
  loses an eye, 300.
    his arm, 300.
  his advice to midshipmen, 299.
Neon discovered, 239.
Neptune discovered, 233.
New Age, miracles of, 351.
Newcomen, 16, 75.
Newcomen's pumping-engine, 15.
Newton, Sir Isaac, 170, 228–233.
Nightingale, Florence, 165.
  Nursing School founded, 165.
Nile, source discovered, 194.
Ninnes and Mawson, 205.
Nitrate, Chilean and artificial, 246.
Nitro-cellulose process of silk-making, 112.
Nitrous oxide, Davy discovers powers of, 158.
Nobile, General, 198.
Norton and Everest, 201–203.
Nyassa discovered, 193.

Oates, Captain, and Scott, 207.
Odell and Everest, 203.
Oil-engine, Diesel, 44.
Old Age Pensions, 287.
Open-hearth steel-making process, 88.
Origin of Species, 259.
Orlebar, Squadron Leader, 67, 68.
Otto, Dr., and gas-engines, 54.
Oxygen discovered, 234.
  solidified, 242.

Paddle-wheels, first used, 31.
  versus propellers, 41.
Page, Handley, Father of giant aeroplane, 64.
    invents safety-slots, 64.
Papin, Denis, invented the safety-valve, 14.
Paris Metro, 27.
Parker, Alexander, invents celluloid, 343.
Parker, Sir Hyde, and Nelson, 300.
Parliament grants Cartwright £10,000, 105.
    Crompton £5000, 100.
  origin of, 281, 283.
Parsons, Sir Charles, invents steam turbines, 43.
Pasteur, 159.
Paul, R. W., and cinematography, 345.
Peary and North Pole, 204.
Peel, Robert, and carding-machine, 94.
Peel, Sir Robert, 96.
Peking skull, 256.
Periodic law, 238.
Perkin, Sir William, discovers coal-tar dyes, 119–120.

Persecutions, 286.
Perthes, Boucher de, 254.
Petrie, Sir Matthew Flinders, discoveries in Egypt, 177–178.
Phonograph, 135.
Picard, 232.
Piltdown skull, 255.
Pitt and Canada, 265.
Plimsoll, Samuel, fights for load-line in ships, 44–45.
Pneumatic tyre, invention of, 59–62.
  tyres first used in 1846, 62.
Postal reform and Penny Post, 288.
Potter, Humphrey, and Newcomen's engine, 17.
Power-loom invented by Cartwright, 103–105.
Preece, Sir William, and wireless experiments, 136.
Prehistoric man, 254, 256.
Prestwich, Sir Joseph, 254.
Priestley discovers oxygen, 234.
Propellers first used for steamers, 38–43.
  versus paddle-wheels, 41.
Purcell, 211.

Queen Victoria and Faraday, 128.
Quintin, Mr. J. C. St., and French loans, 331.

R 34 makes first return trip across Atlantic, 65.
R 100 and R 101, 65.
Railway boom, 26.
  City and South London, 26–27.
  the world's first, 24.
Railways, 24–28.
  amalgamate, 26.
  Inner Circle, 27.
  Metropolitan, of London, 27.
  New York, 27.
  Paris Metro, 27.
Raleigh, Sir Walter, and Queen Elizabeth, 262.
  and Spanish Armada, 292.
Ramsay, Sir William, his discoveries, 238–240.
Raphael, 213.
Rawlinson and cuneiform, 171–174.
  escapes death, 173.
Rayleigh, Lord, discovers argon, 239.
Record, motor-boat, 47.
  motor speed, 66.
Red Cross, 166.
Red flag hampers mechanical road transport, 53.
Redesdale, Lord, on American default, 333.
Regulations, ridiculous, 8.
Rembrandt, 214.
Renshaw, Dr., and trench fever, 165.
Repington, Colonel, and shell shortage, 313.
Revolution, French and Russian, 287.
Reynolds, Sir Joshua, 214.
Rhodes, Cecil, 195.
Richards, Windsor, and basic steel, 80.
Robinson Crusoe, 187.
" Rocket," Stephenson's locomotive, 25.
Roebuck, Dr., helps Watt, 16.
Rolls-Royce, first cars, 56–57.
Ronalds, Sir Francis, and first electric telegraph, 129.
Rosetta Stone, 170.
Ross, Sir Ronald, and malaria, 163, 164.
Rosse, Earl of, 43.
Rothamsted Experimental Station, 247.
Rothermere, Lord, and India, 272.
Royal Society and Davy's notes, 128.
Royce, Sir Henry, 54–57.
  early days, 55.
Rubber, romance of, 59–60.
Russia, debt to Britain, 327.
  present state of, 8.
Ruyter, Admiral de, 295.

Safety-valve invented by Papin, 14.
Salisbury, Lord, and rubber industry, 59.

Sambon, Dr. Louis, and typhus, 164.
Savery, 16, 75.
Scapa Flow, German fleet scuttled, 319.
Schneider Trophy, 66.
Schwabe, Louis, and artificial silk, 111.
Scott and the South Pole, 206–208.
his letter to England, 208.
Scout movement, 288.
Screen, a new television, 147.
Sea roads, 29.
Segrave, Sir Henry, wins motor-boat record and meets death, 46.
wins motor speed record, 66.
Selfridge, Gordon, and television, 144.
Selkirk, Alexander, is marooned, 187.
Sennacherib, his palace revealed, 175.
Shackleton and South Pole, 204.
Shakespeare, 219–224.
Shaw, Bernard, 226, 227.
Shearer, W. B., and Naval Conference, 323.
Sheep, a new breed of, 245, 246.
Sheffield and steel industry, 75.
Shell shortage, 313.
Shelley, 226.
Shipbuilding, British statistics, 45.
Shop-fronts of stainless steel, 87.
Shuttle improved by John Kay, 91.
Siemens, Friedrich, 88.
Siemens, Sir William, 88.
Siemens-Martin process of steel-making, 88.
Silicon steel invented by Hadfield, 84.
Silk, artificial, the romance of, 109–118.
Simpson and chloroform, 156.
opposes Lister, 160.
Sir Patrick Manson founds Tropical Medicine, 160–163.
"Sleepy sickness" and vaccination, 155.
Small-pox, 152–155.
Smeaton builds Eddystone Lighthouse, 71.
Smith, Professor G. Elliot, and Piltdown skull, 256.
Smith, Sir Francis, introduces use of propellers, 39–43.
Smith, Sir Sidney, defeats Napoleon, 297.
Smuts, Hon. J. C., 278.
Snowden, Right Hon. Philip, and France, 327.
at the Hague, 335–339.
Socialism, 290.
Soddy and Ramsay, 239.
Soho Works lit by gas, 125.
Somervell and Everest, 201–203.
Sopwith, Thomas, and amphibian aeroplane, 63.
Spain plunders Peru and Mexico, 290.
Spanish Armada, defeat of, 292–294.
Spectroscopic analysis, 238.
Speke, Captain John, and Nile, 194.
Spenser, Edmund, 219.
Spinning-box for viscose silk, 116.
-jennies wrecked, 95.
-jenny invented, 94.
-mule invented by Crompton, 96–100.
Sport, British influence in, 340.
Spruce trees and artificial silk, 118.
Stainless steel, 86.
Stanley in Africa, 193–194.
Stapledon, Professor, and new grasses, 247.
Statistics, army and financial, 324–339.
London passenger services, 27.
Steam-car, the first, 50.
-engine invented by Watt, 12.
-locomotive invented by Murdock, 18.
patented by Trevithick, 19.
turbines, invention of, 43.
Steamships and propellers, 38–43.
birth of, 29–48.
iron, 38.
Stearn, C. H., and artificial silk, 113.

Stearn, C. H., experiments with viscose silk, 116.
Steel and its alloys, 70–88.
basic process, 78–81.
Bessemer, 75.
crucible invented by Huntsman, 73.
heat-resisting, 88.
its manifold uses, 72.
manganese, invented by Hadfield, 82.
rails, first used, 84.
ships, 43.
silicon, invented by Hadfield, 84.
stainless, how invented, 86.
Stephenson, George, 18.
builds first locomotive, 23.
early days, 21.
Stephenson invents miner's safety lamp, 24.
mends watches, 22.
Stephenson, Robert, is born, 22.
Stevenson, R. L., 180.
Stockton and Darlington Railway, 24.
Stokes, Sir George, and wireless waves, 136, 137.
Stone Age, 253, 256.
St. Paul's and stainless steel, 87.
building of, 212–213.
St. Peter's, 213.
Submarine campaign, 317, 318.
Suffragettes, 284.
Sullivan, Sir Arthur, 211.
Supermarine wins world's speed record, 66.
Swan, Captain, 186.
Swan, Sir Joseph, invents artificial silk, 112.
invents electric light, 122.
Swinburne, 226.
Swinburne, James, and inventor of electric lamp, 123.
Symington, William, and Lord Dundas, 32.
invents the steamship, 30–36.
Watt's opinion of, 19.
Symington's steamship a success, 33.
Taung's skull, 256.
Taynton, William, and television, 145.
Taxation in Britain, France, etc., 329.
Telegraph cables improved, 131.
first electric, 129.
patented, 131.
Telephone invented, 134–135.
Television, first apparatus, 144.
romance of, 141–148.
screen, brilliant new, 147.
Temperature, low records, 242.
Tetley, Mr., becomes interested in viscose silk, 115.
Textile machinery, invention of, 89–108.
Thomas, Sidney Gilchrist, and basic steel, 78–81.
Thompson, Francis, 145.
Thomson and Atlantic cable, 132.
Thomson, R. W., invents pneumatic tyre, 61.
Thomson, Sir J. J., discovers electrons, 240, 241.
Tirpitz, von, 316.
Titian, 213.
Toll-gates and early steam-cars, 51.
Topham, C. F., and artificial silk, 113.
invents wonderful spinning-box, 116.
Tower Bridge, 70.
Trafalgar, battle of, 302.
Trees turned into silk, 118.
Trench fever, 165.
Trevithick, Richard, a letter from, 20.
death of, 20.
drives steam-car on road, 50.
his high-pressure engine, 19.
invents locomotive, 19.
patents his locomotive, 19.
Tromp, Admiral van, 295.
Tube railways, 27.
Turbines, invention of, 43.
Turner, J. M. W., 215.
Tutankhamen, tomb discovered, 178.
Tyndall and Faraday, 127.

United States joins Allies, 317, 318.
what Britain has paid, 329.
what Britain has received, 329.
what Britain owed, 328.
Ur of the Chaldees, 171.

Vaccination, 152–155.
Vacuum flask invented, 243.
Valve, thermionic, how invented, 137–141.
Verdun, battle of, 319.
Victoria Falls discovered, 193.
Victoria, Queen, and Faraday, 128.
appoints Simpson as her physician, 157.
Viper, H.M.S., and turbines, 43.
Viscose silk, difficulties of spinning, 116.
early difficulties, 117.
invented by Cross and Bevan, 114.

Waghorn, Sir H. R. D., 68.
Wagner, 210.
Wallace, Alfred Russel, and *Origin of Species*, 259.
War debt statistics, 326–339.
South African, 276.
Water, how it stores heat, 12.
Waterloo, battle of, 304.
Watt, James, and Boulton, 16.
and Roebuck, 16.
invented the steam-engine, 12.
on Symington, 19.
opposes steamships, 32.
supplies engine for power-loom, 104.
Watts, G. F., 216.
Wellington defeats Napoleon, 304.
Wells, H. G., 226.
Wheats, breeding new, 248, 252.
Wheatstone and electric telegraph, 130.
Wickham, Sir Henry, collects rubber seeds, 59–60.
Wilcocks, M. J., escapes death in Segrave disaster, 46.
Wilkinson and iron ships, 37.
William of Orange, 286.
Wills explores Australia, 190.
Wilson, Dr., and Scott, 208.
Wilson, President, and Versailles Treaty, 320.
Wilson, Robert, invents propeller, 42.
Wilson, Thomas, builds first iron passenger boat, 37.
Wireless, first signals sent and received, 136.
signals across Atlantic, 139.
telegraphy, birth of, 136.
telephony, romance of, 137–141.
the master patent, 140.
Wolfe, General, wins Canada, 264.
Woolley, L., and excavation, 171.
Worcester, Marquis of, invents new engine, 75.
World's motor-boat record, 47.
Wren, Sir Christopher, 212–213.
Wright, Orville and Wilbur, 63.

Young, Dr. T., and hieroglyphics, 168–171.
Ypres, defence of, 319.

Zeppelin, 65.
Zeppelins and London, 312.

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